AQUACULTURE IN CANADA'S ATLANTIC AND PACIFIC REGIONS

Report of the Standing Senate Committee on Fisheries

First Session
Thirty-Seventh Parliament

June 2001

AQUACULTURE IN CANADA'S ATLANTIC AND PACIFIC REGIONS

Interim Report of the Standing Senate Committee on Fisheries

Chair
The Honourable Gerald J. Comeau

Deputy Chair
The Honourable Joan Cook

June 2001

MEMBERSHIP

37th Parliament - 1st Session

THE STANDING SENATE COMMITTEE ON FISHERIES

The Honourable Gerald J. Comeau, *Chair*
The Honourable Joan Cook, *Deputy Chair*

And

The Honourable Senators:
Adams
Callbeck
Carney, P.C.
*Carstairs, P.C. (or Robichaud, P.C.)
Chalifoux
*Lynch-Staunton (or Kinsella)
Mahovlich
Meighen
Moore
Robertson
Watt

The following Senators also served on the Committee during its study: The Honourable Senators Corbin, DeBané, Forrestall, Graham, Hubley, Johnson, Kenny, Milne.

36th Parliament - 2nd Session

The Honourable Gerald J. Comeau, *Chair*
The Honourable Fernand Robichaud, P.C., *Deputy Chair*

And

The Honourable Senators:
Adams
*Boudreau, P.C. (or Hays)
Carney, P.C.
Cook
Johnson
*Lynch-Staunton (or Kinsella)
Mahovlich
Meighen
Perrault, P.C.
Perry
Robertson
Watt

*Ex Officio Members
The following Senators also served on the Committee during its study: The Honourable Senators Furey, Squires.

ORDER OF REFERENCE

37th Parliament – 1st Session

Extract from the *Journals of the Senate* of Tuesday, March 13, 2001:

The Honourable Senator Comeau moved, seconded by the Honourable Senator Di Nino:

That the Standing Senate Committee on Fisheries be authorised to examine and report upon the matters relating to the fishing industry;

That the papers and evidence received and taken on the subject during the Second Session of the Thirty-sixth Parliament be referred to the Committee;

That the Committee submit its final report no later than March 31, 2002; and

That the Committee be permitted, notwithstanding usual practices, to deposit any report with the Clerk of the Senate, if the Senate is not then sitting; and that the report be deemed to have been tabled in the Chamber.

The question being put on the motion, it was adopted.

Paul C. Bélisle

Clerk of the Senate

36th Parliament - 2nd Session

Extract from the *Journals of the Senate* of Tuesday, December 7, 1999:

The Honourable Senator Comeau moved, seconded by the Honourable Senator Lynch-Staunton:

That the Standing Senate Committee on Fisheries be authorized to examine and report upon the matters relating to the fishing industry;

That the Committee report no later than December 12, 2000; and

That the Committee be permitted, notwithstanding usual practices, to deposit its report with the Clerk of the Senate, if the Senate is not then sitting; and that the report be deemed to have been tabled in the Chamber.

After debate,
The question being put on the motion, it was adopted.

Paul C. Bélisle

Clerk of the Senate

TABLE OF CONTENTS

Page

PREFACE i

INTRODUCTION 1

A. GLOBAL OVERVIEW 1
B. CANADIAN AQUACULTURE 4

THE FEDERAL ROLE 10

ISSUES RAISED 17

A. THE DFO'S SUPPORT OF AQUACULTURE 17
B. EMPLOYMENT AND ECONOMIC DEVELOPMENT 22
C. THE SITING OF FISH FARMS 27
D. ENVIRONMENTAL CONCERNS ABOUT SALMONID AQUACULTURE 35
E. ESCAPING FARMED SALMONIDS 41
F. FISH HEALTH 49
G. SHELLFISH AQUACULTURE, ENHANCEMENT 57
H. SCIENCE, RESEARCH AND DEVELOPMENT 61

CONCLUDING REMARKS 68

RECOMMENDATIONS 72

APPENDICES

FAO CODE OF CONDUCT FOR RESPONSIBLE FISHERIES, ARTICLE 9 – AQUACULTURE DEVELOPMENT - APPENDIX I 75

WITNESSES - 37TH PARLIAMENT – 1ST SESSION - APPENDIX II 78

WITNESSES - 36TH PARLIAMENT – 2ND SESSION - APPENDIX III 80

EXHIBITS - 37TH PARLIAMENT – 1ST SESSION - APPENDIX IV 82

EXHIBITS - 36TH PARLIAMENT – 2ND SESSION - APPENDIX V 83

MEETINGS & TOURS - APPENDIX VI 87

PREFACE

I want to applaud this Committee's ongoing study of aquaculture in Canada. ... The issues you have raised here are extremely important for me and my Department, and I will do everything I can to address them. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 4 April 2000

I think that this Committee could do a service to Canadians in holding the Department's attention – to hold its feet to the fire, if I might be so crude. It should be ensured that the work that is planned is carried out... – Ronald C. Thompson, Assistant Auditor General, International Affairs, Proceedings, 2 May 2001

One aspect of my job is to keep DFO's feet close to the fire so that the Department meets all of its goals with respect to its action plan and it $75 million program. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 29 May 2001

We have ... asked for a copy of the legislative review that has been prepared by the office of the Commissioner of Aquaculture Development within DFO. This we understand was finished last year and has never been released. ... This is typical of the way information about this industry is treated, both at the federal and provincial levels of government. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001

Mr. Bastien's document indicates that he wants to make the Fisheries Act a toothless creation. – Lynn Hunter, Fisheries and Aquaculture Specialist, the David Suzuki Foundation, Proceedings, 9 May 2001

My view is that if the Auditor General conducted the evaluation of salmon farming on both coasts on 1 April 2001, the Auditor General would find that there has been a significant effort by the Department. While there may be some issues that are still outstanding, that the bulk of the issues have been resolved and that we are making some significant progress forward. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001

There were many reasons for undertaking a study on aquaculture, not the least of which is that farmed fish and shellfish ultimately end up on our dinner plates. The international fishing industry is undergoing an historic transition, with aquaculture (also known as "fish farming" or "aquatic farming") becoming the source of a steadily increasing percentage of seafood consumed world-wide. In Canada, we are told that aquaculture: is a rural-based industry providing much-needed employment and numerous economic spin-offs for rural coastal communities hard hit by depletions in wild fish stocks; acts in a supporting role to the wild fishery; provides indisputable opportunities in related technology and service sectors; and offers tremendous opportunities for further development. Canadians are also told that constraints to the sector's expansion cost jobs and that government's support and approval of industry expansion should naturally follow.

In keeping with its mandate and mindful of costs, the Committee conducted a series of informal, fact-finding meetings in the Atlantic and Pacific regions in 2000 to: familiarize members with the issues facing the fisheries; and discover, first-hand, the specific challenges and constraints facing the marine aquaculture sector. These informal discussions involved various stakeholders and designated members of the Committee, or "working groups." The meetings took place in boardroom-type settings, as well as in the form of visits to a number of research laboratories and facilities, finfish and shellfish farms, and processing plants. In addition to oral presentations, the Committee welcomed written briefs and letters. These deliberations were supplemented by the use of videoconferencing and by more formal and recorded hearings in Ottawa.

Aquaculture represents about one-quarter of the landed value of fish in Canada. From our in-the-field visits, we can certainly attest to the fact that there are many examples of successful fish farming enterprises on both coasts of Canada. With only two decades of significant commercial production, Canada's aquaculture sector is a relatively new industry, but also one that is growing and evolving. Its complexion and level of development changes notably from one province to the next, with opinions being more deeply divided in some regions than in others. Some communities embrace aquaculture as an economic generator, while others have

misgivings. A variety of fish species are cultivated in Canada, but much of the lively and sometimes contentious debate centres on the possible environmental consequences of salmon farming, especially in British Columbia and New Brunswick where almost all of the farmed salmon in Canada is produced.

Generally speaking, industry regulation has fallen short of the expectations of conservationists and environmental groups, commercial fishermen, Aboriginal peoples, recreation and tourism interests, waterfront property owners, and other users of the shoreline. Some believe aquaculture and traditional fishing to be mutually exclusive. A perceived lack of willingness on the part of the salmon farming industry to provide others with information on their activities contributes to an overall climate of distrust. Advocates of aquaculture, on the other hand, believe that the regulatory framework is cumbersome, expensive and unduly restrictive. Salmon growers, in particular, repeatedly cautioned that "half-truths" and "unsubstantiated accusations" about their industry were being put forward publicly. Communication, i.e., "getting the right message out" to the public and media, was considered to be a priority by both proponents and industry critics alike.

Canadian aquaculture is at a critical juncture in its evolution. One of the challenges faced by government now and in the years ahead will be to achieve a delicate balance between various competing users of the marine environment (a common property resource). For the Department of Fisheries and Oceans (DFO), whose motives and agenda on aquaculture were frequently questioned in the Committee's discussions, this will be easier said than done. Opinions on the industry are divided, but there is at least some common ground in the form of shared interests and objectives. For example, neither side wants to see the escape of farmed fish, or transmission of disease, and both want a clean environment as well as more research. In at least some respects, aquaculturists, environmentalists, conservationists and fishermen are potential allies. The task at hand will be to build on common interests and cooperate to ensure that aquaculture will in future be environmentally sustainable and economically successful. Meaningful public involvement will also be necessary to address perceptions of industry secrecy and government's failure to respond.

One immediate and positive result arose from one of our meetings in St. Andrews, New Brunswick, on 29 February 2000, with representatives of the Department of Fisheries and Oceans Biological Station, the Huntsman Marine Science Centre, the Atlantic Salmon Federation, the New Brunswick Department of Fisheries and Aquaculture, and the New Brunswick Salmon Grower's Association. Prior to the meeting, the representatives had spent a good deal of time identifying and agreeing on science-based issues. Subsequent to the Committee's visit, the five groups agreed to meet again, and this eventually led to a proposal for collaborative research to better understand the ecosystem of the Bay of Fundy, where most of the province's salmon production originates. We were later informed that this spirit of cooperation would not have happened without the stimulus provided by the preparations made in advance of the Committee's visit. Such dialogue between various interests should be encouraged in order to create more cooperative relationships. We hope that more of this will take place in future.

Clearly, aquaculture promises great returns in many areas. This is especially so in Nova Scotia and Newfoundland, regions where finfish farming is relatively new and where participants can learn from past mistakes. This is also the case for the farming and enhancement of shellfish, activities that are generally considered to be environmentally friendly and that appear to offer economic opportunities for small entrepreneurs and fishermen alike.

Equally clear is that there are legitimate environmental concerns, especially if the salmon farming sector is to expand. This became more evident as the Committee heard more presentations. At this point in time in the sector's development, it may be fairly said that science firmly supports neither side of the environmental debate. Indeed, our "fact-finding" exercise points to the need for much more scientific research "to ascertain the facts" surrounding many of the issues identified in this report. Suffice it to say that this will be no small task. In British Columbia, for example, a five-volume, 1,800-page Salmon Aquaculture Review (SAR) published by the province's Environmental Assessment Office, in August 1997, concluded that at current levels of production, salmon farming in B.C. posed a low risk to the environment. That report, however, recommended that a number of new studies be conducted, and strongly cautioned that there were "significant gaps in knowledge" – which has since become an often-used refrain by industry critics.

A number of major developments, government announcements and reports on the industry occurred during the course of our inquiry. In August 2000, for example, the federal Minister of Fisheries and Oceans announced the Program for Sustainable Aquaculture (PSA) – which includes $75 million in new funding, over five years. In February 2001, the Auditor General of Canada tabled Chapter 30 of his December 2000 report. That month, an Expert Panel established by the Committee on Expert Panels of the Royal Society of Canada – a federally appointed, independent scientific body – also released a report on the regulation of food biotechnology in Canada that contains an important chapter on aquaculture. As the first phase of a legislative and regulatory review of aquaculture, the Commissioner for Aquaculture Development submitted 36 recommendations to the federal Minister of Fisheries and Oceans in June 2000; his report, dated March 2001, was made public in late April 2001. Meanwhile, the DFO has been developing a detailed action and implementation plan, which was also recently made public. In British Columbia, where more than two-thirds of Canada's aquaculture output is produced, the newly elected provincial government there might decide to change its fish farming policies or lift a moratorium that was placed in April 1995 on the issuance of new conventional salmon farm tenures. At the time of writing, New Brunswick was in the process of reviewing applications for new salmon grow-out sites. A new federal aquaculture Act may, in future, be introduced in Parliament.

In many respects, this report is a snapshot in time. Although aquaculture and enhancement is a growing activity in the inland provinces, we limited the scope of our study to the maritime coastal provinces that dominate Canada's production. The complex, dynamic and shared jurisdictional nature of the industry also forced us to focus on the more important themes. The industry's reaction may well be that the contents of this document are based largely on speculation and on outdated information because of huge improvements in technology, husbandry, and farm siting. Similarly, the DFO may respond that recent departmental programs – such as the PSA, and initiatives of the Canadian Council of Fisheries and Aquaculture Ministers – are responding to concerns.

We appreciate the keen interest shown by those who so generously made time available to participate in our review. This included finfish and shellfish farmers, fish farm workers, interest groups, research scientists, veterinarians, members of the public, and federal and provincial government officials, including the Minister of Fisheries and Oceans who appeared before the Committee on two occasions. Some matters were beyond our terms of reference dealing with aquaculture, and cannot be dealt with in this report. The dissolution of Parliament and the November 2000 federal election considerably delayed our work.

The Standing Committee on Fisheries and Oceans of the House of Commons has undertaken a similar inquiry on aquaculture. We look forward to the Committee's report.

Lastly, I would like to thank the Honourable Ray Perrault of British Columbia and the Honourable Melvin Perry of Prince Edward Island, who have since retired from the Senate, for their tireless efforts and valuable contribution to our study. The Committee is indebted to Claude Emery, Research Officer of the Library of Parliament; his knowledge of fisheries as well as his research, analytical and writing skills are greatly appreciated. We also wish to thank our Clerk, Barbara Reynolds, for her exceptional organizational skills, especially in planning our fact-finding visits. We also acknowledge the valuable assistance received from Anne Marleau, our Administrative Assistant, in keeping all our documents in order.

Gerald J. Comeau

Chair

REPORT ON AQUACULTURE IN CANADA'S ATLANTIC AND PACIFIC COASTAL REGIONS

INTRODUCTION

A. Global Overview

> *I believe that aquaculture is now entering a new phase in its development. ... I am absolutely convinced that when our descendants look back, in the year 2100 or 3000... , they will view the dawn of the third millennium as the point at which mankind went from fishing to aquaculture. – Yves Bastien, DFO Commissioner for Aquaculture Development, Speaking Notes, Aquaculture Canada '99 Trade Show, Conference and Fair, Victoria, B.C., 27 October 1999*

> *I believe that Canada can position itself appropriately. In that way, the Canadian aquaculture and wild fish industries can benefit from Canada being the best in the world in terms of ocean management, food safety, environmental quality, aquatic animal health and overall industry services. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001*

> *World-wide – in virtually every place in the world – coastal environments are seriously degraded because they have been the recipients of well over 200 years of industrial activity. ... (W)orld-wide, salmon aquaculture is the last straw for many coastal environments. ... We are talking about industrial scale feed lots for fish. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001*

Aquaculture – the cultivation of aquatic organisms, including finfish, shellfish (molluscs and crustaceans), and aquatic plants – is an established practice in many parts of the world and has its roots in ancient times. The Chinese, for example, have been refining their fish culturing techniques for thousands of years. As in agriculture, "aquaculture" (or fish farming) implies some form of intervention (e.g., regular stocking, feeding, and protection from predators). Unlike the traditional capture fisheries, aquaculture implies some form of ownership of the stocks being cultivated.

Globally, total production of cultured fish, crustaceans and molluscs in 1998 was more than 39.4 million tonnes, with Canada contributing less than 3% to this amount. Fish farming has seen phenomenal growth, encouraged by: the rise in demand for fish products (due to population increase and changes in dietary preferences); aquaculture's continuity of supply, consistency of quality, and control over production (e.g., size, fat content); scientific advances in nutrition, disease control, rearing techniques, and genetics; technological developments in designing fish-rearing installations; and major declines in the world's major wild fisheries. Resource economists assert that most major stocks of commercial fish have either been fully exploited or are being excessively harvested, and that growth in traditional fisheries is over.

Aquaculture has not only become the source of an increasing percentage of seafood consumed throughout the world, but is also considered to be the fastest-growing agri-food production activity – a trend this Committee predicted more than a decade ago, in its 1987 report on fish marketing.(1) Over the past decade, output is said to have grown at an average overall annual rate of 12%, with some sectors achieving annual growth rates of 20%. World-wide, aquaculturists produce more than one-quarter of the global food fish supply. For the next 10 to 15 years, the Food and Agriculture Organization (FAO) predicts sustained growth, with total production reaching between 35 to 40 million tonnes by the year 2010, or between 35 to 40% of the total fisheries production by weight. Up to 40% of international revenues generated by fish may result from fish farming. In North America alone, demand for seafood is expected to increase by as much as 40% by the year 2010.

Since its inception in the early 1980s, the salmon industry has grown exponentially. In 1997, for the first time, the world's production of farmed salmon of just over 900,000 tonnes surpassed the global wild catch of 728,000 tonnes. Farmed salmon is worth more than $7 billion, about four times the value of the world's wild harvest of salmon; and more growth for salmon farming is foreseen, particularly in Norway and Chile, with production projected to reach 1.9 million tonnes during the decade. Globally, other trends include lower production costs, the diversification of product lines, and industry rationalization – a trend that began in the 1990s and

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(1) Standing Senate Committee on Fisheries, *The Marketing of Fish in Canada: Interim Report on the West Coast Fisheries*, December 1987. See also Department of Fisheries and Oceans, *Commercial Aquaculture in Canada*, Supply and Services Canada, 1988, p. 3.

that is expected to put continued downward pressure on prices and possibly harm smaller producers' ability to compete.

Aquaculture is often heralded as the next step in an evolutionary process, similar to that which led to our obtaining meat from farming and ranching rather than from hunting. Others are of the opinion that aquaculture will continue to supplement the traditional capture (or "wild") fisheries, but will never entirely displace them because wild stocks of fish, when properly managed, tend to have high reproductive rates and can generally withstand high harvest levels.

There has been increasing global concern and controversy about the possible impacts of aquaculture on the marine environment or ecosystem. For example, aquatic farming is promoted by some to be the logical way to lessen fishing pressure on threatened or declining wild fish stocks, and to "help feed a hungry world." That view is challenged by those who contend that the consumption of farmed finfish, such as salmon, is likely to have the opposite effect. For one thing, it is said that the industry relies heavily on pelletized feed made from wild-caught fish harvested off the shores of developing countries (e.g., South American anchoveta, jack mackerel, sardine); for another, the species farmed are mostly luxury food items sold in the developed countries. Several people in our discussions also spoke of the "fish meal dilemma," which they characterized as both a moral and economic problem: they said it takes 3(or 4) kg of wild-caught fish to produce one kg of farmed carnivorous fish (e.g., salmon) for market. In other words, a net loss of fish protein results in this so-called "protein-short world." One witness put it this way:

> Salmon farms are remarkably inefficient at converting biological industrial inputs into product. ... (T)o "manufacture" the food required by a salmon farm, the farm requires the marine support area of 40,000 to 50,000 times the surface area for cultivation. In other words, for every square meter of a fish farm net area, you require between 40,000 and 50,000 square meters of ocean surface area to produce the fish that those salmon will eat. ... (T)he European fish farming industry requires the production of 90 per cent of the North Sea to keep it afloat. Therefore, 90 per cent of the primary production in the North Sea, at present, is going toward fish farming, which is the direction that we are taking. Right now, the industry is succeeding on the backs of the South American fisheries, but now they are slowly kicking us out. We will be forced to extract those resources from other waters. – John Volpe, Department of Biology, Centre for Environmental Health, University of Victoria, *Proceedings*, 9 May 2001.

Others, however, assert the following claims: the feed conversion ratio has greatly improved in recent years; species harvested to produce fish meal/fish feed are those not normally consumed by people and have little commercial value; aquaculture feeds represent a small percentage of the world's total production of animal feeds derived from fish; and fish produce more protein than is obtained from land-based meat production.(2) On the amount of harvest needed to produce fish feed, we were reminded that an ecosystem is a complex web; as such, significant tinkering with any part of it can set up a continuum of results that flow throughout the whole.

B. Canadian Aquaculture

> *Through annual growth rates in our market of 10 to 20%, aquaculture in Canada could easily reach $2 billion a year in sales later in this decade. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000*

> *'Will Canada be a world leader in aquaculture or a secondary player? ... We are starting out ... with a rather ironic handicap – a strong fishing industry and a still abundant supply of marine resources. ... It is up to us to capitalize on the immense expertise of the fisheries sector ... and join with them in R&D, industrial partnerships and joint projects that meet the needs of both sectors. – Yves Bastien, DFO Commissioner for Aquaculture Development, Speaking Notes, Aquaculture Canada '99 Trade Show, Conference and Fair, Victoria, B.C., 27 October 1999*

> *... (T)here is an enormous divide between what the salmon farming industry and their supporters within government say and what members of the environmental community, First Nations and independent scientists say on this topic. – Lynn Hunter, Fisheries and Aquaculture Specialist, the David Suzuki Foundation, Proceedings, 9 May 2001*

> *We did not think that we wanted to take on the whole of the country. We felt that would be somewhat unmanageable for something that seemed as tricky as aquaculture, and so we limited the scope to the West Coast and to the effect on wild salmon stocks. Perhaps our scope could have been broader... – Ronald C. Thompson, Assistant Auditor General, International Affairs, Proceedings, 2 May 2001*

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(2) About 21% (or 31 million tonnes) of the world's total wild fisheries production (mostly small pelagic fishes, such as anchovy, jack mackerel, herring, and sardine) is converted to animal feeds. About 15% of this total is said to be used in fish feeds.

In Canada, aquatic farming is not an entirely new endeavour. By the early 1880s, the federal government had been operating a network of fish hatcheries geared to public stocking programs.(3) In fact, Canadians are recognized the world over as pioneers in the field of fish farming. However, it was not until the 1970s that facilities began to produce on a commercial scale. In the 1980s, Canadian aquaculture grew very quickly to become a thriving commercial industry providing direct and indirect economic benefits to many regional and local economies. Today, the industry is a mosaic of small, medium, and large-scale vertically integrated operations. It also varies across the country as to its size and age. Commercial ventures have been established in all ten provinces and in the Yukon Territory. The species cultivated include finfish (e.g., salmon, trout, sea trout or "steelhead," Arctic char, tilapia, perch, walleye), plants (a variety of seaweed), and shellfish (e.g., oysters, clams, scallops, mussels). New species (e.g., cod, wolffish, haddock, halibut, flounders, sturgeon, striped bass, abalone, sea urchins, sea cucumbers, prawns, clams, scallops) are in the experimental stages of development or being cultured in small quantities.

Broadly speaking, several factors have helped to spur the Canadian industry: an increase in the overall demand for seafood domestically and in export markets; declining populations of wild stocks; the fact that traditional capture fisheries that have reached their limits; improvements in production and transportation techniques; and proximity to the United States market. In aquaculture, once the appropriate size of the species being cultivated is reached, the "crop" is harvested, processed and shipped to market, often arriving within hours of leaving the water. Unlike the cyclical wild fisheries, aquaculture affords a predictable and stable supply of product to market.

At $429 million in 1998, aquaculture accounts for approximately one-quarter of the total value of the fish and seafood produced in Canada (Tables 1 and 2). About 70% of Canada's production is exported, primary markets being the United States and Japan. Canadian producers are, however, relatively minor players in global terms; the amount produced represents less than 1% of the total value of world output. Although regulation is perceived by its producer members as an impediment to growth, the Canadian industry has been growing at a remarkable pace. The volume of output, which has doubled since 1989, is said to be expanding at an impressive

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(3) In those early years, hatchery production concentrated on salmon and trout to augment or re-establish wild populations, or to establish populations where none had existed before. Other species have been farmed for some time. For example, Pacific oysters have been cultivated in B.C. since the 1920s, making shellfish culture the oldest sector of the aquaculture industry on the West Coast of North America.

average rate of about 15% per year; if production predictions are met, the industry will exceed $1.5 billion in sales by the year 2005. Aquaculture is said to have enormous potential for growth because of Canada's 244,000 kilometres of largely untapped coastline on the Pacific, Arctic and Atlantic oceans, its abundant freshwater resources, its reputation for high-quality fish products, and its world-class science and technology infrastructure. Many hope that, with a commitment of resources, Canada will once again become a major world producer of seafood, a position that has been in decline since the 1950s.

Table 1 – Canadian Aquaculture Production, 1998
(Tonnes)

	401	-	1,785	14,232	-	-	-	-	-	42,200	58,618	(2)
	48	-	-	550	835	3,580	14	875	-	60	5,962	(2)
	1,316	-	1,038	-	-	-	-	-	-	-	2,354	(2)
											402	(1)
	1,765	**99**	**2,823**	**14,782**	**835**	**3,580**	**14**	**875**	-	**42,260**	**67,435**	
	-	-	-	-	-	-	-	-	-	704	704	
	-	1,974	377	286	-	-	-	-	-	5,500	8,137	
	946	12,459	835	680	98	-	-	-	-	-	15,018	(2)
	9	-	21	-	-	-	-	-	-	40	70	(2)
	7	-	10	-	30	-	-	-	-	-	47	
	962	**14,433**	**1,243**	**966**	**128**	-	-	-	-	**6,244**	**23,976**	
	2,727	**14,532**	**4,066**	**15,748**	**963**	**3,580**	**14**	**875**	-	**48,504**	**91,411**	

(1) includes Char, Other Finfish and Total Alberta Finfish.
(2) excludes Confidential Data.
(3) excludes "other" for provinces.

Note: Some data are confidential and not reported; subtotals are therefore greater than the sum of the data listed. The production and value of aquaculture include the amount and value produced on sites, and exclude hatcheries or value added products. The data are collected from each of the provincial departments responsible for aquaculture.

Source: Department of Fisheries and Oceans, Statistical Services.

Table 2 – Canadian Aquaculture Production, 1998
($'000)

	2,925	-	10,540	106,678	-	-	-	-	-	228,900	349,043	(2)	2.70
	197	-	-	6,100	3,340	14,200	62	3,859	-	300	28,058	(2)	2.13
	6,919	-	6,095	-	-	-	-	-	-	-	13,014	(2)	2.51
											3,862	(1)	4.36
	10,041	**882**	**16,635**	**112,778**	**3,340**	**14,200**	**62**	**3,859**	**-**	**229,200**	**394,859**		
	-	-	-	-	-	-	-	-	-	3,619	3,619		2.33
	-	4,447	1,186	788	-	-	-	-	-	4,900	11,321		0.63
	815	15,110	1,458	1,455	147	-	-	-	-	-	18,985	(2)	0.57
	53	-	135	-	-	-	-	-	-	300	488	(2)	3.16
	32	-	23	-	180	-	-	-	-	-	235		2.27
	900	**19,557**	**2,802**	**2,243**	**327**	**-**	**-**	**-**	**-**	**8,819**	**34,648**		
	10,941	**20,439**	**19,437**	**115,021**	**3,667**	**14,200**	**62**	**3,859**		**238,019**	**429,507**		

The source and notes for Table 1 also apply to Table 2.

In Canada, the cultivation of finfish accounts for the largest percentage of aquaculture's annual output; finfish accounted for 74% of total aquaculture tonnage in 1998-1999, and 92% of the industry's value. The balance of production came from the shellfish sector, which accounted for about 24,000 tonnes valued at $34 million. Salmonids[4] are the most popular cultivated species because of established farming methods and markets. The Atlantic salmon (*Salmo salar*) has become the major choice of Canadian salmon growers for a variety of reasons, including faster growth rates, greater tolerance for higher stocking densities, superior disease resistance, and more efficient feed conversion rates. About 85% of Canada's production is Atlantic salmon, the other species being steelhead trout, and chinook and coho on the West Coast. When fish farming was first introduced in British Columbia in the 1970s, two species of Pacific salmon (chinook and coho) were farmed almost exclusively. Later, for economic reasons, salmon farmers switched predominantly to Atlantic salmon.

(4) "Salmonids" are fish of the family Salmonidae, such as salmon, char, and steelhead trout.

Most of the farmed salmon in Canada is produced in British Columbia and New Brunswick, where aquaculture is a firmly established and well-developed activity. Geographically, salmonid farming in the Pacific and Atlantic regions is also strongly localized. In British Columbia, most farms are located in the waters of the Broughton Archipelago, on the mainland coast next to the north-east coast of Vancouver Island. On the East Coast of Canada, the largest concentrations of this sector are found in the Bay of Fundy where the powerful tides are said to provide an ideal environment for cultivation. In B.C., where about two-thirds of the total Canadian output is produced, farmed salmon has become the largest agri-food export. The sector also has the highest level of foreign ownership; two multinational companies control more than half of the province's production. In New Brunswick, where ownership is less concentrated, there are strong linkages with its counterpart in the State of Maine in terms of investment by New Brunswick producers.

Levels of salmonid production are considerably smaller in Newfoundland and Nova Scotia – provinces that are relative newcomers but that have nonetheless experienced high rates of growth in recent years. The activity is also expected to expand considerably. In Newfoundland, the production of finfish is mostly steelhead trout and Atlantic salmon. Shellfish aquaculture is based primarily on mussels, and the province's strategic plan also focuses on the grow-out of Atlantic cod. Nova Scotia's finfish sector is based primarily on the rearing of salmonids, but many other species are cultivated as well. Unlike the situation elsewhere, the aquaculture sector there was said to be diverse, not concentrated in any one particular region, with sufficient water available to it for expansion. The hope was often expressed to us in Nova Scotia that the province would become a world leader in alternative species development.

The salmon farming cycle begins with the collection of eggs and milt from broodstock (on-farm broodstock, wild stock, or an imported source) selected for their known desirable characteristics (e.g., fast growth, disease resistance, flesh colour). Fertilized eggs are incubated in freshwater in a controlled hatchery environment (primarily in round fibreglass tanks) where temperature, oxygenated water, and other conditions are managed. The fish are usually inoculated, sometimes individually, to prevent disease and, once a specific size or developmental

stage is reached, they are transferred to grow-out sites. These so-called "salmon farms" typically consist of a series of large netted, suspended, cage-like structures placed in flowing, open, near-shore marine (saltwater) sites. Netting to deter predators is commonly placed around the perimeter of the cage. In this setting, the fish are given specific diets of pelletized feed (a major production cost for finfish) until they reach marketable size. We were told that flesh colour and fat content can also be manipulated depending on the type of feed and colouring agent used. The length of the seawater grow-out phase depends on the species and stock being raised, smolt size, water temperature, feeding practices, and a variety of other factors. For salmonids, this phase can last anywhere from 12 to 16 months. Put simply, the goal is to grow the largest quality fish, in the shortest possible time, and at the least possible cost. With about 6% of total world production, Canada is the world's fourth-largest producer of farmed salmon after Norway, Chile and the United Kingdom.

Mussels, oysters and a variety of clams are the mainstay of those who cultivate shellfish, a species group that is very much in demand. Shellfish farming evolved from a series of local experiments to become a thriving industry in Nova Scotia, New Brunswick, Newfoundland, Quebec, British Columbia and Prince Edward Island. On both coasts, shellfish farms are primarily small and medium-size, owner-operated companies. In PEI, which is the largest shellfish producer, five processors account for the majority of shellfish production; blue mussels predominate. Canadian shellfish aquaculturists compete primarily with producers in the United States (mainly from the states of Washington, Oregon, North and South Carolina, Florida and Virginia). Other competitors are located in Chile, New Zealand and Asia.

The growing process for shellfish begins with the collection of seed stock (or "spat") normally from the wild, or from hatchery production. Unlike finfish aquaculture, the ebb and flow of tides and water movement provide the basic food source for shellfish. Thus, successful shellfish farming depends on: the ability to grow the seed over time in areas where there are sufficient nutrients in the water; steady and reliable water temperature ranges and flows; and favourable climatic conditions such as wind and weather. Depending on the species being cultured, the grow-out stage may involve bottom culture (where the growing takes place on the sea bed), near-bottom culture (on structures constructed on the bottom), or off-bottom culture (on structures suspended in the water between the surface and the bottom). For example, scallop

larvae may be collected in the wild by using mesh bags stuffed with a special type of material. There they may be grown until collected and transferred to appropriate sites on the ocean bottom, or on hanging lines.

THE FEDERAL ROLE

Part of the problem with aquaculture is that some jurisdictions are divided between provincial and federal governments. We need to look at how to harmonize some of those. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000

This industry does not have parity with either the wild fishery or with terrestrial farms, so there is a competitive disadvantage... – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001

If you look back over the course of time, and the events which I have recounted, I am sure that you will understand if I tell you that the aquaculture sector has heard the talk but is still anxious to see the walk. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 22 February 2000

Quebec recognizes the need to work in conjunction with the federal government to improve consistency and harmonize the legal and regulatory regimes regarding aquaculture. Quebec believes that such discussions need to be conducted bilaterally and not within the federal-provincial group. – Rémy Trudel, Minister of Agriculture, Fisheries and Food, In Reaction to the Recommendations of the Task Group on Aquaculture and the Program for Sustainable Aquaculture, 17 August 2000

Five years ago, if an individual applied for a site licence, that individual had to go through 22 departments and/or agencies, federal and provincial. After all the work we have done in five years, we have it down to only 15. – Jerry Ward, Assistant Deputy Minister, Department of Fisheries and Aquaculture, Newfoundland and Labrador, Proceedings, 4 October 2000

Huge progress has been made in terms of working with the federal government on environmental assessments and permitting approval. – Peter Underwood, Deputy Minister, Department of Agriculture and Fisheries, Nova Scotia, Proceedings, 15 May 2001

Aquaculture straddles the line between fishing and farming. More significantly, compared to other countries, the Canadian jurisdictional context is complex and unique. Unlike the case of the traditional common property (capture) fisheries, the responsibility for overseeing aquaculture is shared between the provinces (and territories) and the federal government.

Although the *Constitution Act, 1867* does not specifically mention aquaculture, judicial interpretation of constitutional powers makes it clear that the provinces have the power to regulate many of its aspects. The most far-reaching provincial authority is over property and civil rights. The scope of permissible provincial regulation includes the following: the management and use of Crown land; the licensing of aquaculture operations; the setting of standards for the business of aquaculture and those who conduct it; local marketing and consumer protection; waste management; and labour relations and employment standards. Some provinces have proclaimed Acts dealing with aquaculture, while at the local level, regional districts and municipalities administer zoning bylaws. With one exception,[5] the provinces are responsible for aquaculture planning, site leasing, and the majority of approvals for aquaculture sites, aquaculture training and education, the collection of statistics, the promotion of fish and aquaculture products, and the management of the industry's day-to-day operations.

The Parliament of Canada also enjoys constitutional power that touches on the subject of aquaculture. This includes the power to legislate in relation to federal public property, sea coast and inland fisheries, navigation and shipping, and Indians and land reserved for Indians. These powers have been interpreted to allow the federal Parliament to pass laws to: preserve and protect the environment of wild fish; control marine traffic and pollution in Canadian waters; and require environmental assessment of projects that have any effect on matters within federal legislative jurisdiction.

Aquaculture is not defined as a fishery under the *Fisheries Act,* although the Act's provisions pertaining to fish habitat (section 35) and the deposit of deleterious substances into water frequented by fish (section 36) apply to it. Under the authority of the *Fisheries (General) Regulations* made pursuant to the *Fisheries Act*, the DFO may authorize activities such as the

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(5) All provinces are responsible for issuing licences for aquaculture operations, except Prince Edward Island, which decided in 1928 to leave that responsibility with the federal government.

collection of fish for stocking or artificial breeding from the wild stocks, and the release of live fish into fish habitat. Pursuant to the *Fisheries Act*, the *Management of Contaminated Fisheries Regulations* give the DFO the ability to close any fishery where toxicity or contamination reach unacceptable levels. The federal *Fish Health Protection Regulations* require all shipments of live salmonids (including eggs) into Canada or between provinces to come from facilities certified as being free of certain diseases. The *Fish Inspection Act* and its regulations govern the safety and quality of fish products. The *Navigable Waters Protection Act* – one of the oldest pieces of federal legislation – protects the public's right of navigation. The *Canadian Environmental Assessment Act*, the *Feeds Act*, the *Health of Animals Act*, the *Food and Drugs Act*, the *Canadian Environmental Protection Act,* the *Pest Control Products Act,* and the *Migratory Birds Convention Act* are other important federal statutes.

Also, the responsibility for regulatory enforcement is sometimes split between departments within each level of government. At the provincial level, regulations are overseen by health departments, environmental departments, fisheries departments, lands and forest departments, agriculture and transportation departments, labour department worker safety requirements, and a host of aquaculture site-specific local rules and requirements. In British Columbia, for example, we were told that more than 14 federal, provincial and municipal departments and agencies are directly and indirectly involved in the regulatory and management process of fish farming. Regulations and required management practices may cover issues ranging from worker safety requirements on fish farm sites, to specifying the equipment and supplies used to construct and operate the fish farms (e.g., the use of materials that bio-degrade, the content of fish feed, the testing of water quality, the use of antibiotics).

At the federal level, the DFO plays the lead role, with 16 other federal departments and agencies having responsibilities relating to aquaculture.[6] Committee members were informed that an Interdepartmental Aquaculture Steering Committee, chaired by the DFO, has been formed for matters that require consultation and discussions between them. They were also

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(6) The federal departments and agencies involved in aquaculture include the Department of Fisheries and Oceans, Environment Canada, Industry Canada (the Atlantic Canada Opportunities Agency, Western Economic Diversification Canada, the Federal Development Initiative in Northern Ontario, the National Research Council, Canada Economic Development for Quebec Regions), Statistics Canada, the Canadian Resources Development Agency, Human Resources Development Canada, Health Canada (the Bureau of Veterinary Drugs, the Pest Management Agency), the Canadian Environmental Assessment Agency, Agriculture and Agri-Food Canada, the Farm Credit Corporation, the Canadian Food Inspection Agency, Natural Resources Canada, the Department of Foreign Affairs and International Trade, the Department of Indian and Northern Affairs, the Department of Finance, Canadian Heritage, and the Natural Sciences and Engineering Research Council.

reminded that, over the past 20 years, the DFO had been involved in numerous reviews and studies reinforcing the potential of the aquaculture industry in Canada. The following bullet points briefly summarize the major federal initiatives in support of aquaculture:

- In the 1970s and 1980s, the DFO established a core science capability that helped build the aquaculture industry in Canada and in some other countries.
- In 1983, the DFO and the Science Council of Canada sponsored the First National Aquaculture Conference.
- In 1984, the Prime Minister named the DFO as the lead federal agency responsible for aquaculture.
- In 1986, First Ministers agreed to a statement of national goals and principles for the development of aquaculture.
- Between 1986 and 1989, Memoranda of Understanding (MoUs) were negotiated and signed with six provinces and one territory, to clarify the delineation of responsibilities between the levels of government. This was followed by the launching of MoU implementation committees. The MoUs are "customized" to meet the needs of the industry in each province or territory and have been used over the years for the administration of the industry.
- In 1988, the Standing Committee on Fisheries and Oceans of the House of Commons (then chaired by the chair of this Committee) tabled a study entitled *Aquaculture in Canada,* which recommended that the federal Fisheries Minister take a pro-active role in supporting aquaculture development in Canada. The House Committee recommended that a senior-level service headed by an Assistant Deputy Minister be created "to serve as the co-ordinative focus for all aquaculture activities particularly those taking place within the Science Sector."
- In 1989, the Standing Senate Committee on Fisheries tabled a study on the marketing of Atlantic fishery products (Report III on the East Coast Fisheries). During its deliberations, it was suggested to the Committee that the DFO establish a section within its organizational structure to deal specifically with aquaculture and to coordinate the efforts of various other government departments. The Committee recommended that the DFO create a senior-level service headed by an Assistant Deputy Minister to coordinate all aquaculture activities. In his November 1990 response, the Minister of Fisheries and Oceans "disagreed" with this proposal, stating that it was premature to consider an ADM for aquaculture, and that a new position of Director of Aquaculture had been approved to coordinate departmental and governmental activity.
- In 1990, the DFO launched a strategy for the development of aquaculture.
- In 1992, the DFO appointed a Director of Aquaculture Policy to provide leadership for aquaculture development within the Department and the federal government. Shortly after, departmental and inter-departmental Aquaculture Steering Committees were established, followed by the first Aquaculture Planning Forum in Montreal.
- In 1994, the DFO commissioned a national opinion poll that revealed widespread public support for aquaculture development.

- In 1995, the DFO announced the Federal Aquaculture Development Strategy (FADS), a framework or "blueprint" for federal initiatives in support of industry development. The Strategy identified aquaculture as a legitimate user of land and water and a priority for the federal government, and confirmed the DFO as the lead department within the federal government.
- In 1996, a Liberal Caucus Task Force on Aquaculture led by George Rideout and Herb Dhaliwal concluded in a report (entitled *Aquaculture: Cultivating Potential*) that the federal government has an obligation to actively assist and promote aquaculture. The Task Force recommended that responsibility for aquaculture be given to a separate agency, headed by a Deputy Minister (DM) or equivalent, to initiate, advance and coordinate all government activities related to aquaculture.
- In 1997, the Liberal government announced its commitment for federal support of aquaculture. The federal Liberal Party's 1997 election platform (*Securing our Future Together: Preparing Canada for the 21st Century*) stated that improved support for the aquaculture industry by the federal government and its agencies would foster more rapid growth of the industry. The document contained a promise to appoint a Commissioner for Aquaculture Development who would report to the Minister of Fisheries and Oceans.
- In December 1998, Mr. Yves Bastien, the first-ever federal Commissioner for Aquaculture Development, was appointed for a four-year term. The creation of this position was a direct response to a policy commitment made by the government in the 1997 federal election.
- In April 1999, the DFO established its Aquaculture Restructuring and Adjustment Directorate to consolidate the Department's policy and programs in cooperation with the newly appointed Commissioner.
- In June 1999, the Department held two roundtables – one with stakeholders and one with provinces and territories – to review the state of the industry and to determine whether the Federal Aquaculture Development Strategy was still relevant. At the roundtables, the 1995 Strategy was confirmed as the appropriate approach for the federal government to take; participants urged the federal government to implement the FADS without further delay.
- In August 1999, Herb Dhaliwal was named Minister of Fisheries and Oceans, at which time the Minister immediately stated that the development of a sustainable aquaculture was a priority.
- In September 1999, in Quebec City, the Minister of Fisheries and Oceans signed an agreement on inter-jurisdictional cooperation with his provincial and territorial counterparts to identify shared priorities. The federal/provincial/territorial ministers unanimously endorsed the goal of making Canada a world leader in sustainable aquaculture.
- In October 1999, the federal government announced the launch of a new Aquaculture Partnership Program (APP) aimed at helping the industry in the various regions to develop partnerships and to collaborate on projects of national or regional significance. Later, in April 2000, the Fisheries Minister and the Commissioner for Aquaculture Development announced $401,650 in funding for four projects under the APP.
- In April 2000, the Atlantic Council of Fisheries Ministers (ACFM) recognized the importance of aquaculture for Canada through the inclusion of "aquaculture" in the official title of the Council for future meetings.

Under the 1995 Federal Aquaculture Development Strategy, federal initiatives in aquaculture have been primarily directed toward: supporting infrastructure (i.e., research and development, education and training, etc.); creating a regulatory and policy framework conducive to industry development; and improving industry/government partnerships. We were informed that the implementation of the FADS was delayed in the years immediately following its release. This was because no resources were available to implement the Strategy as a result of severe budgetary cuts within the federal government.(7)

As noted previously, the federal government has since renewed its commitment to federal support of aquaculture. In brief, the DFO told the Committee that it had adopted a multi-pronged approach to the sustainable growth of aquaculture. The Department has been working to put in place an updated policy framework for operational decision-making. Under the auspices of the Canadian Council of Fisheries and Aquaculture Ministers (CCFAM), a Task Group was established as a mechanism for intergovernmental cooperation and information-sharing. A national code for sustainable aquaculture is being developed, and it is hoped that it will be linked to local industry codes that have already been developed.

The Department has also made a commitment to make strategic investments in federal capacity to support and to promote the Federal Aquaculture Development Strategy. The establishment of a new DFO Directorate was said to be the first step in that direction. On 8 August 2000, the federal Minister of Fisheries and Oceans announced the Program for Sustainable Aquaculture; this includes $75 million in new funding, over five years. The investment: aims to strengthen the ties between levels of government, the scientific and academic communities, and the industry itself; and is intended to provide the public and private sectors with opportunities to conduct leading-edge research and development, to strengthen measures to further protect human health through an enhanced shellfish water quality monitoring program, and to implement a legislative and regulatory framework for the industry.

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(7) In 1995, the DFO terminated the position of Director, Aquaculture Policy, due to lack of resources. During this period, the Department withdrew from freshwater aquaculture, and wound down its aquaculture program in the Central and Arctic Region and in the Laurentian Region.

The new funding includes: $32.5 million for Science, and Research and Development (which includes $20 million for the Aquaculture Collaborative Research & Development Program, or ACRDP); $20 million for a Human Health Program; and $22.5 million for an Improved Management and Regulatory Framework. Also announced was the establishment of an Office of Sustainable Aquaculture (OSA), which is responsible for: implementing changes to the legal and regulatory framework for aquaculture; updating the DFO's policy framework for operational decision-making; working with the provinces to establish federal-provincial mechanisms for cooperation and harmonization; and overseeing strategic investments in federal capacity to support and promote the FADS.(8)

In the first phase of his *Legislative and Regulatory Review of Aquaculture in Canada*, the Commissioner for Aquaculture Development submitted 36 recommendations to the Minister of the DFO in June 2000, which were made public in April 2001.(9) The report's proposals deal mostly with policies, many of which are "considered to be temporary until more fundamental legal gaps are addressed." Currently, the DFO is addressing the report's recommendations on aquatic animal health, and on government-ordered eradication of fish (and compensation) through a National Aquatic Animal Health Program. The second phase of the review is expected to clarify and define the key policy principles in aquaculture, which the Aquaculture Commissioner deemed "essential prior to the overhaul of the current legal regime."

The DFO's strategic plan for aquaculture has two objectives: first, "to increase public confidence in environmentally sustainable aquaculture development"; second, "to increase the industry's global competitiveness." To achieve these objectives, the Department has developed an action plan based on four themes: a healthy environment; healthy fish and quality products; the shared use of our aquatic resources; and a competitive industry. The action plan in turn consists of five core activities: the Program for Sustainable Aquaculture; the creation of an enabling policy environment; the development of a national aquatic animal health strategy and

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(8) Department of Fisheries and Oceans, "A Program For Sustainable Development," *Backgrounder*, August 2000.

(9) The review focused on three objectives: to provide the aquaculture sector with clear and transparent rules; to ensure that there is a stable environment in the long term; and to provide government officials with clear and consistent guidelines on how to apply current policies and regulations to the aquaculture sector.

program; increased federal-provincial harmonization of various aquaculture activities (in recognition of the shared jurisdictional nature of the aquaculture sector); and the creation of an enabling regulatory environment.

On the regulatory environment, short-term work currently underway by the Department includes:

- clarification of the Canadian Environmental Assessment Agency (CEAA) process as it applies to aquaculture with the development of a national guide outlining information requirements to assess the environmental effects of marine aquaculture;
- development of a national guidance document on the application of section 35 of the *Fisheries Act* to aquaculture;
- development of a report on the application of section 36 of the *Fisheries Act* to aquaculture;(10)
- the finalization of an introduction and transfer code for aquatic organisms;
- the development of national guidelines for the application of fish management authorities to aquaculture;
- development of guidelines for *Navigable Waters Protection Act* (NWPA) site design and marking for aquaculture; and
- a review of the duration of NWPA approvals.

ISSUES RAISED

A. The DFO's Support of Aquaculture

> *I do not see finfish aquaculture as a replacement for wild stock but only as an addition to economic opportunity. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000*

(10) Section 35 deals with harmful alteration, disruption or destruction of fish habitat; section 36 prohibits the deposit of deleterious substances in waters frequented by fish.

I am planning to develop a full comprehensive communication strategy. The Department will do the same. The aquaculture industry has been subject to a fair bit of negative campaigning. ... More and more we see bumper stickers that read "wild fish do not do drugs," among other things. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 22 February 2000

We now have a federal Minister of Fisheries who has clearly stated his position on aquaculture. All provinces ... can see a change in the attitude of senior bureaucrats in Ottawa. Historically, it was clear that they were not supportive of moving forward on aquaculture. – Jerry Ward, Assistant Deputy Minister, Department of Fisheries and Aquaculture, Newfoundland and Labrador, Proceedings, 4 October 2000

We believe that it is unconscionable and completely inappropriate to allow DFO, as a regulating agency, to act ... as a proponent for the salmon farming industry. – Laurie MacBride, Georgia Strait Alliance, Brief, 22 February 2000

... (S)enior officials from the Department of Fisheries and Oceans said that their top objectives relating to aquaculture were to increase public confidence in the industry and to increase its global competitiveness. These are not the tasks of a regulatory agency; they are the tasks of a public relations firm. – Lynn Hunter, Fisheries and Aquaculture Specialist, the David Suzuki Foundation, Proceedings, 9 May 2001

The DFO's vision for aquaculture is to improve and enhance the sector so that it "reaches its full potential in a sustainable way." To this end, the Department has concentrated its efforts in a number of areas: reviewing the legal and regulatory framework as led by the Commissioner for Aquaculture Development; developing a better and more consistent departmental policy framework for aquaculture; enhancing federal/provincial/territorial cooperation through the new Council of Canadian Fisheries and Aquaculture Ministers (CCFAM); and enhancing DFO programs in support of the 1995 Federal Aquaculture Development Strategy (FADS).

It soon became apparent during the course of this review that not everyone supports the Department's objectives. The DFO's mandate, for both the promotion of aquaculture development and the protection of wild fish stocks and habitat, obviously puts the Department in a difficult situation. Committee members were often told that there is an inherent and growing conflict of interest between the two, that there is a "lack of balance," and that the Department has

assumed an advocacy (or "cheerleading") role in support of fish farming at the expense of its responsibility for wild fish and their habitat.

Also questioned was the creation of the Office of Commissioner for Aquaculture Development, who has been described as a separate node of activity within the Department, and the Commissioner's $600,000 annual budget to promote aquaculture (under the Aquaculture Partnership Program). Critics argued there was no need for this, given the many associations that already represent the fish farming industry and its strong voice in the Canadian Aquaculture Industry Alliance.(11) In British Columbia, the more vocal opponents of aquaculture alleged that the DFO had become the "public relations arm of the industry," and by actively promoting aquaculture, especially sea-cage salmon farming, had failed to protect wild fish and their habitat from the ecological impacts of that industry. It was suggested that the Department had not only written off the wild fisheries, but had also abdicated its legal responsibility for wild salmon stocks on which coastal fishing communities depend.

In contrast, supporters of fish farming stated that Canadian aquaculturists had been operating under an outdated policy and regulatory framework that, for the most part, had been designed for the traditional capture fisheries and thus conflicted with the further development of the industry. They stressed that they did not want weak regulations, but rather regulations that were appropriate to their business. Generally speaking, they viewed government regulation as unduly restrictive, especially when compared with that of other countries, and as an erected obstacle to increased production and competitiveness. Complaints were made about "bureaucratic red tape." Some said that, over the years, federal agencies had been reluctant supporters of fish farming because of their traditional working relationships with the commercial wild fishery and because of the DFO's mandate for the protection of the marine environment and fish stocks. Because, in their view, their industry had not received the recognition or support it deserved from the Department, they believed that a re-balancing of governmental priorities was needed to recognize aquaculture as "a legitimate user of the aquatic resource." The following illustrate the comments made on this theme:

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(11) The Alliance is a national sector council initially sponsored by the Department of Human Resources Development to represent the interests of Canadian aquaculture operators, feed companies and suppliers, as well as provincial finfish and shellfish aquaculture associations.

The challenge for the Department is to successfully integrate its lead agency role for aquaculture with its mandate of ensuring the protection of the wild resources and the oceans. This integration will be completed when the 9,000 employees of the (DFO) will be convinced that aquaculture does not create any more impact on the environment than fisheries, and that aquaculture represents the only valid alternative to obtain sustainability in the overall fisheries and seafood sector. – Yves Bastien, DFO Commissioner for Aquaculture Development, *Proceedings*, 22 February 2000.

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The recent appointment of the new federal Commissioner for Aquaculture Development, the establishment of an aquaculture directorate within DFO, and Minister Dhaliwal's public support of the aquaculture industry have been very encouraging to our association. However, strong opposition to aquaculture within the DFO bureaucracy has thwarted any positive actions that these initiatives may have had. ... When there is a conflict with traditional fisheries, no matter how small or insignificant, aquaculture is the loser. Fundamental change and leadership is required within DFO. There needs to be a developmental attitude towards this growth industry, rather than a regulatory attitude. ... This industry, up to now, has been built on hopes and dreams with not a lot of support – in fact, with many obstacles thrown in our path. However, we are pioneering Canadians and we will continue to fight the good fight. – Ruth Salmon, Executive Director, B.C. Shellfish Growers Association, *Proceedings*, 30 May 2000.

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We are facing a revolutionary change which will require the privatization of a previously 100% public resource. The government often plays the role of guarding the public resource against all new intruders and those who presently have pseudo-ownership of the public resource through the present licensing system ... don't want to have to share the resource with others. Those who are the current owner – fishermen and environmentalists – see new participants in the ownership of resources as a threat. As these are ownership issues, government gets involved and this adds to the resistance to change because historically the wild fisheries have been the government's "clients" and "environmentalists" have developed ways to have a disproportional influence on governments. – Dr. Brad Hicks, *Brief*, 31 March 2000.

Committee members were told that, compared to other countries, such as Japan[12] (where no distinction is made between aquaculture and fisheries and where the two are integrated and perceived to be complementary activities with the common purpose of "providing fish to a growing market"), the two sectors in Canada had become polarized to the extent that some believe that we can only have one or the other. Spokespersons for the industry said that aquaculture complements the traditional wild fishery (e.g., by evening the seasonality of fish processing), and repeatedly cautioned that the debate had resulted in the dissemination of "highly accusatory" and "erroneous information." They warned Committee members not to be misled by the "counterproductive opposition." Salmon growers believed that the communication of this message would be a major challenge.

DFO officials who appeared before us stressed that the Department was not focusing on aquaculture to the detriment of its other responsibilities (e.g., the conservation of wild fish stocks, the protection of fish habitat, marine and navigational safety, and the implementation of integrated oceans management). Rather, its priority was to ensure – through legislation, regulations, policies and programs, and in its relations with other federal agencies and levels of government – that aquaculture is recognized as a legitimate user of the aquatic resources. As one spokesperson for the Department put it:

> Whatever changes are made to federal regulations respecting aquaculture, they will be made to recognize the legitimacy and promote the sustainability of the industry, while acknowledging and respecting other interests. – Michel Leclerc, Special Advisor, Aquaculture, Policy Sector, Department of Fisheries and Oceans, *Proceedings*, 4 April 2000.

It is noteworthy that the Auditor General's December 2000 report gave the DFO a failing grade in carrying out its regulatory responsibilities to enforce the *Fisheries Act* with respect to salmon farming in British Columbia. The Auditor said there was a widely held view within the Department that salmon farming, in some instances, had adverse effects on fish habitat.

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(12) Japan was cited as an illustrative example of a country that had been integrating aquaculture and the traditional fisheries since the early 1960s as means of promoting its coastal fisheries. That country was said to use aquaculture technology on about 80 species, including those under technical development. Major successes were reportedly achieved with scallop, flounder, sea bream, prawn, urchin and abalone.

B. Employment and Economic Development

For local and coastal communities, there are tremendous opportunities. We have the longest coast line of any country in the world. We have three oceans around us. This is a huge asset for Canada. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 4 April 2000

... I foresee the day when these two sectors will be fully integrated into a seafood sector where the distinction between an aquaculturist and a fisherman will not be important because everyone will be involved in producing wealth from our oceans co-operatively, in a sustainable manner. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 29 May 2001

I hope I did not mislead you on the issue of jobs. It is not my view that traditional fishers and those associated with the traditional fishery will be made into aquaculturists. If that is the impression I left, then it is the wrong one. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 8 February 2000

The industry does not have the ability to raise the capital required from the traditional charter banks in this country. ... (The Farm Credit Corporation is) not mandated to take risk. They are mandated to make a profit. – Jerry Ward, Assistant Deputy Minister, Department of Fisheries and Aquaculture, Newfoundland and Labrador, Proceedings, 4 October 2000

I am a displaced fisher. ... There is no employment in fish farming. Out of 40 sites, there are 80 jobs, and there are 8,000 Kwakuitl – 40 jobs when there used to be at least 400 jobs a couple of years ago. That has happened because of the displacement of fish stocks by fish farming. – Pat Alfred, President, Kwakuitl (First Nations) Fisheries Commission, Proceedings, 9 May 2001

All of these jobs have been replaced by computer – particularly the more labour-intensive jobs such as cleaning nets, which is now automated. The idea that aquaculture will provide income for coastal communities is somewhat, I would say, in doubt. – John Volpe, Department of Biology, Centre for Environmental Health, University of Victoria, Proceedings, 9 May 2001

For many, aquaculture has emerged as an unquestionably bright light in the development of the seafood industry. Governments tend to view aquaculture in terms of economic development. Advocates of aquaculture on both the East and West coasts argue that further expansion will revitalize remote and economically depressed coastal communities, particularly those hit hardest by declining traditional (capture) fisheries and industry restructuring. For them, fish farming holds the promise of diversifying local economies, expanding employment, increasing capital investment, and strengthening the commercial fishery as a whole; however, a more conducive policy and regulatory environment must first be established.

Canada's aquaculture sector currently employs about 14,300 people (7,300 in production and processing, and 7,000 in supply and services) across the country, mostly in rural and coastal areas, where 90% of production and processing jobs are located. This number is said to have been growing at an annual rate of 12% since 1995. Members of the Committee were told that workers under the age of 30 hold approximately half of those jobs, and that about 90% of the aquaculture businesses in Canada is Canadian-owned. Indirect benefits have been created in related industries, such as equipment manufacturing, feed production, processing and transportation, and marketing and consulting services. Technical expertise such as veterinary services, seed collection, lab testing, and ongoing research and development in many areas are all required. As the industry matures and becomes more based in science and technology, there will undoubtedly be many more employment opportunities for workers with higher skill levels.

On their tours of fish and shellfish rearing sites, Committee members were often reminded of beneficial economic effects in rural areas where unemployment is relatively high. Unquestionably, aquaculture is a significant economic generator in some parts of the country. For example, in New Brunswick, we were told that salmon farmers produce the largest "crop," or twice the value of the potato industry, and that one in four private-sector jobs in Charlotte County is related to aquaculture. From its in-the-field visits, the Committee can certainly attest to the fact that there are many examples of vibrant and very successful enterprises on both of Canada's coasts.

At first glance, aquaculture would appear to be suited to rural Canadians, Aboriginal communities, and small entrepreneurs. Sometimes it is proposed as a means of employment or self-employment for displaced commercial fishermen who already possess the necessary handling skills, boats and gear. Others note, however, that the expertise and mind-sets required in traditional (capture) fishing are very different from those required in fish farming. As the Commissioner for Aquaculture put it when he appeared before us, "not all fishermen want to be aquaculturists. They want to fish."[13] Fishermen, for their part, tend to view aquaculture as a competitor affecting the environment and market prices, and their access to fishing grounds. In a related vein, fish farmers do not consider themselves to be fishers and tend to view their activity as being more like agriculture. On employment, some people stated that there was a shortage of persons with adequate training and experience to fill technical and management positions in new commercial ventures, especially where new species are being developed.

The hope was expressed that fishers, who are able to see for themselves the merits of fish farming, will support or participate in this activity in a meaningful way. On this, Committee members learned about the seasonal growing-out of cod in Newfoundland (on the West, Northeast and South coasts of the province). Akin to aquaculture, this activity has been conducted on a limited basis in recent years to demonstrate its commercial potential. Live wild fish are caught in conventional cod traps and transferred to licensed holding cages sites for six to eight months. In 2000, there were 18 active sites. This type of endeavour has a number of advantages, including: no need whatsoever for hatchery or early rearing facilities,[14] and a relatively short payback time. Fishermen are able to double the size of their fish in as little as three months, and bring their product to market when prices are highest. The results of this initiative were said to be very encouraging in terms of creating economic activity in rural communities that have been affected by the collapse of the northern cod fishery. The constraints to its further development were said to be the cost of feeding the fish and the unreliability of access to cod.

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(13) Yves Bastien, DFO Commissioner for Aquaculture Development, *Proceedings*, 22 February 2000. When the Commissioner was appointed in December 1998, he set out with three objectives, one of which was to convince the fisheries sector of the benefits of fish farming and the advantages of participating more actively in it. The other two objectives were to undertake a review of the legal framework governing aquaculture, and to improve public perceptions of the industry.

(14) The other approach is the development of full-cycle cod aquaculture from hatchery-reared cod, which is in the research and development stage.

For other types of finfish, access to investment and operating capital was deemed to be a major challenge or constraint to new entrants and the further expansion of aquaculture. Several people spoke of the substantial funds needed, particularly during the start-up years of a fish farming operation. It was explained that aquaculturists often have difficulty obtaining loans because of the time it takes for their "crops" to reach marketable size and generate a return on the investment. The time required in turn depends on the species cultivated. With respect to finfish, the possible outbreak of disease makes it more risky for lenders. Unlike terrestrial agriculture where land can be used as collateral, the lender has no such security if an aquacultural crop fails. On this, one positive development for some was the Farm Credit Corporation (FCC), a federal Crown corporation, which offers financing services to primary producers in aquaculture to assist with the expansion or upgrading of hatcheries, grow-out-sites, or processing businesses (e.g., for the purchase of barges, cages, nets, smolts, feed, tanks, pumps, processing equipment, construction costs, land and site leasing). A number of projects are also funded through other federal agencies, such as the National Research Council's Industrial Research Assistance Program, Human Resources Development Canada, and the Atlantic Canada Opportunities Agency (ACOA). We were told that without ACOA, there would not be an aquaculture sector in Newfoundland.

As earlier noted, the DFO's strategic plan for aquaculture consists of two main objectives, one of which is to increase the industry's global competitiveness. On this matter, some critics stated that the global growth of salmon farming, the production from which has exceeded that for all other species, had changed the economic viability of the wild fishery. Moreover, because salmon aquaculture had become such a highly competitive business on the global market, Canadian producers have become price-takers who will need to reduce their production costs in order to remain competitive. One witness put it this way: "The market is tremendously saturated. You have to be a big player now to get a return on your investment because your margins are so small."(15) Others said that capital had fled from this country to Chile and elsewhere, where the investment and regulatory climate is more welcoming. Some

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(15) Inka Milewski, President, Policy, Conservation Council of New Brunswick, *Proceedings*, 24 April 2001. The Aquaculture's Commissioner's recent report states the following: "(T)he industry is now at the point in its business cycle where Canada will not be able to successfully compete in the global marketplace unless costs are reduced..." Office of the Commissioner for Aquaculture Development, *Legislative and Regulatory Review of Aquaculture in Canada*, DFO Communications Branch, March 2001.

saw aquaculture, particularly salmon aquaculture, as experiencing the same trends toward consolidation that have been evident in terrestrial agriculture. Still others argued that the market price of farmed salmon is artificially low because the industry does not bear the environmental costs of production.

In British Columbia, there were accusations that government and the aquaculture industry had been "spinning a one-sided tale of economic opportunity." In that province, salmon farming was said to be dominated by large businesses that had undercut markets and prices for wild salmon, thereby damaging the traditional fishery. Others said that Canadian farmed salmon represents an amount considered to be too small to influence prices. There were also contradictory assertions in regard to the adequacy of wages paid to fish farm workers. In both British Columbia and New Brunswick, the economic values generated by salmon farming were questioned, with two submissions describing the situation in the following terms:

> StatsCan figures for 1997 show that the fish farm industry was a money loser, that the number of jobs the industry supplies is decreasing, and that taxes and fees returned to government amounted to less than $1 million, or less than half a percent of the industry's revenues. While the industry might argue that these figures were a result of the province's moratorium on new farms, the reality is that during the four years that the moratorium was in place (i.e. prior to the province's policy announcement last fall), the BC industry actually expanded its production by 60%. Thus the industry was a money loser even during a time of expansion. ... Figures from Scotland show a similar pattern: increased production at the same time as lessening employment, a financial loss and taxpayer subsidies. – Laurie MacBride, Georgia Strait Alliance, *Brief*, 22 February 2000.(16)

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> It isn't only the indirect cost of environmental damage that the public has borne. Our incomplete survey revealed that up until 1997, tax dollars had directly supported this industry to the tune of at least $40 million, $34 million of this from ACOA. This tally does not include indirect support to the industry through government-funded services, research, training and promotion (including the Office of Aquaculture Development inside DFO). The tax payer has also had to bail out the industry out of trouble. According to the Department

(16) See also the David Suzuki Foundation, "Latest StatsCan Data Showed BC Salmon Farming Industry Operating in the Red," *News Release*, 14 April 1999.

of Agriculture, Fisheries and Aquaculture, between April 1998 and June 2000, 55 farms were infected with the ISA virus... . A total of $44 million of government funding was allocated to the crisis. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, *Brief*, 24 April 2001.

C. The Siting of Fish Farms

It is really more of an issue for the province than for us. ...(I)t is really not something for which we have a direct responsibility. – Lorne Anderson, Acting Director General, Aquaculture Restructuring Adjustment, Department of Fisheries and Oceans, Proceedings, 21 March 2000

Let us be as efficient as we can. Let us not keep people waiting ten months for an approval if there is no need to because we do not have enough people to do the work. Let us ensure that we streamline processes, and do things as efficiently as possible. – Liseanne Forand, Assistant Deputy Minister, Policy, Department of Fisheries and Oceans, Proceedings, 2 May 2001

This industry needs to be able to plan for the future without fear that they will lose tenure. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 8 February 2000

Recreational property owners and developers almost always oppose aquaculture development. ... Protection of the environment is the most commonly stated reason for opposition. ... ... (O)ne of the major impediments to the growth of the industry right now is our ability to gain community acceptance of the industry and deliver sites... Ultimately, the decision whether or not to grant a lease is a political one. – Peter Underwood, Deputy Minister, Department of Agriculture and Fisheries, Nova Scotia, 15 May 2001

We would like to see harmonization – one-stop shopping – whereby our industry would deal with one level of government in the local area and would be able to take care of the bulk of the issues that they need to resolve before proceeding. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001

We were never consulted before placement of these fish farms in our territory; nor did we provide our consent. ... Without consulting to receive consent from my people, you will have a war every time. – Pat Alfred, President, Kwakuitl Fisheries Commission, Proceedings, 9 May 2001

When selecting a site for aquaculture, many factors are taken into account, such as water depth, current flow, salinity, temperature, wind and waves, oxygen content, pollution, ice conditions, proximity of other resource users and tourist sites, patterns of marine traffic, and proximity to suppliers and services (e.g., wharves, roads, air transportation, communications). Thus, the industry is generally constrained by the availability of suitable grow-out sites. Although Canada has approximately 244,000 kilometres of coastline on the Pacific, Arctic and Atlantic oceans, the environment, in particular, is an important limiting factor. For example, in Newfoundland, finfish aquaculture is located in Bay d'Espoir, the only area of the province where the water temperatures are suitable for the growing of salmon and steelhead trout (the primary species raised).(17) Some of the difficulties include high winds and limitations on the number of over-wintering sites as a result of the movement of ice.

Generally speaking, aquaculturists and their representatives told us they needed to have access to new sites, more secure tenures, and longer term approaches to leasing. Lease terms were deemed to be too short; the lack of security of tenure was said to make financing difficult to obtain. Comments were made about administrative problems and the time it takes to approve new sites because of the complexity of regulation and site management requirements. A number of presentations complained about difficulties in obtaining approvals from the Coast Guard.

The approval process for site leases is governed by Memoranda of Understanding (MoUs) between the federal and provincial governments. The Memoranda (signed in the 1980s) were intended to establish a "one-stop shop" approach for lease applicants. They also address a number of other areas, such as research and development, education and training, provincial licensing and regulation, federal regulation, coordination between the parties, dispute resolution, compliance and inspection, the use of therapeutants and vaccines, and recording statistics. There are MoUs in place between the federal government and seven provinces and territories: British Columbia, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and the Yukon. Except in the case of Prince Edward Island, the provinces were said to be the lead agency, and each has developed its own policies and site-specific approval process.

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(17) For salmonids, there are summer cage sites and winter sites, so that every site is fallowed annually. We were told that there had never been a traditional wild fishery in the region.

Decisions on siting are important because they directly relate to the types and the magnitude of the possible impacts of fish farming operations on the ecosystem. Ideally, aquaculture sites should be situated in locations where their potential adverse effects on the ecosystem are minimized while the economic viability of the operations is maintained. Marine environments are also common property resources with no individual owners; the characteristics that make a site suitable for aquatic farming may be similarly valuable for other types of activities (e.g., traditional fishing) or recreational uses of the shoreline. Understandably, the relatively recent appearance of farms in areas where people reside or where other activities already exist or are appearing (e.g., marine eco-tourism) have frequently led to conflict.

Because the use of marker buoys is required, fish farms have a visual impact. Many therefore view an expansion of aquaculture as a potential threat to the coastal tourism industry, one of the fastest-growing sectors of the economy. During the Committee's discussions, individuals and groups raised the following concerns: the aesthetic and economic values of frontage property would decline; recreational and commercial fishing sites might be disrupted; and sheltered anchorage areas, which are vital to the safety of recreational boaters and commercial fishermen, might be lost. On this, a number of aquaculturists and provincial government officials emphasized that good relations within the communities were vital for obtaining and securing lease sites.

> The key to acceptance is employment and engaging the community in the process and in the assessment and monitoring. In those communities where a lot of upfront work has been done by the applicants involving the community, few problems were faced in getting community acceptance and project approval. – Peter Underwood, Deputy Minister, Department of Agriculture and Fisheries, Nova Scotia, *Proceedings,* 15 May 2001.

We heard a number of complaints: the industry had grown in the absence of public information or input; local residents and the public generally were not provided with a strong enough voice or sufficient time to collect information when siting decisions are made; the process for evaluating and approving tenures had been conducted using incomplete or inaccurate information on fish habitat; and the individualized nature of site-by-site environmental evaluations did not allow for integrated regional or coast-wide planning, despite the fact that such assessments are essential so that the particulars of each site can be duly noted.

In some regions, particularly in the Bay of Fundy, it was suggested that salmon aquaculture had outgrown the capacity of ecosystems to support it. The L'Etang Inlet, for example, was described as having the world's highest concentration of aquaculture sites per square km. New Brunswick officials, for their part, pointed out that the total leased area in the Bay of Fundy currently represents less than 0.2% of its total area. On both coasts there were calls for increased funding for estimating the "carrying capacity" of aquatic ecosystems, in order to make better informed siting decisions. We were told that in the case of New Brunswick, the carrying capacity has been exceeded, and that there are too many salmon being grown for the environment to handle. In Newfoundland, we learned that the province had spent $2 million studying the ecological carrying capacity of the ecosystem in that province before devising a strategy to develop the salmonid farming sector.

The siting of salmon farms is especially problematic when it does not adequately take into account proximity to wild fish migration routes. For example, concerns were expressed to us about "pit lamps" being used at night over salmon farms in British Columbia. Some witnesses explained that wild juvenile Pacific salmon that migrate in the vicinity of net cages are attracted to the lights and consumed by farmed fish (thus reducing growers' feed costs, the major cost of production). Wild salmon may also be subject to predation by seals that are drawn to grow-out sites, or exposed to parasitic sea lice, which were said to be more abundant on farms. Other species of marine life, such as eulachons, a traditional food source of Aboriginal peoples, are also attracted and preyed upon by farmed salmon and other predators.

British Columbia has adopted a number of siting criteria for salmon farms (based on the province's 1997 Salmon Aquaculture Review). Under the province's Salmon Aquaculture Policy, salmon farmers are required to indicate that a proposed site for a new or relocated facility meets these criteria. Last year in our deliberations, several people called for a prohibition on farms near rivers and streams supporting wild stocks (i.e., "aquaculture free zones") to minimize interactions between wild and farmed fish. Some groups wanted to see more stringent controls on the spacing or density of salmon farms. We were told that fish farms are not permitted within 1 km of salmon streams and of each other (whereas Norway, for example, does not allow farms within 20 km of significant salmon-bearing streams), but yet there was no scientific justification for the 1 km minimum distance. In the four years that the salmon farm moratorium on new

leases had been in place in B.C., the sector was said to have increased by 60% through raising more fish, or by adding fish pens.[18]

The First Nations we met on our fact-finding tour of British Columbia voiced their vulnerability to the risks associated with salmon farming. For them, the recent development of aquaculture was perceived as the newest industrial threat to traditional wild fisheries, following the onslaught of the exploitive industrial fishery. Other concerns included: the threat to Aboriginal cultures from any loss of their traditional wild fisheries; the unknown health impacts on Aboriginal people from potential contamination of traditional (and still dominant) food sources, especially shellfish; and inadequate involvement in tenure and licence decision-making. As well, Aboriginal people said that they had so far received very few, if any, benefits from aquaculture, and that their involvement in decisions regarding aquaculture over the past two decades had been minimal. They strongly opposed salmon farming in their traditional territories, the areas where most of the province's salmon farming activity is located. They said that existing farming operations were infringing upon their constitutionally enshrined Aboriginal rights, that the government had authorized more than 30 fish farms without consulting them, and that any future expansion of the industry would require not only require consultation with Aboriginal peoples, but also their informed consent.

In British Columbia, the provincial government placed a moratorium on the issuance of new fish farm tenures in April 1995. In July 1996, the Province's Environmental Assessment Office (EAO) was assigned the responsibility of conducting a Salmon Aquaculture Review (SAR), during which members of the public and other stakeholders were consulted and invited to make submissions. Following the release of the SAR report in August 1997, a new provincial fish farm policy was announced in October 1999. One major decision was to maintain the number of conventional salmon tenures at 121. However, it was explained to us last year that the number of farming operations could increase by 50% if all the permits become operational. The province's October 1999 policy also commits the province to relocating poorly sited operations to new areas.[19]

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(18) One farm alone was said to be producing at five times the level approved in its original tenure.

(19) Other aspects of the provincial policy include the implementation of stricter siting criteria to protect environmental, recreational and other resource values, and engaging coastal communities and First Nations in a comprehensive consultation process to ensure that relocated farms have community support. As of 22 May 2001, a total of 11 farms were identified for relocation, four of which have

On 6 February 2001, the Auditor General tabled his December 2000 report in the House of Commons (tabling had been postponed due to the 27 November election). Chapter 30 (on "The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks") looked at whether the DFO was meeting its obligations under the *Fisheries Act*, while participating in the regulation of the salmon farming industry in British Columbia. The Auditor recommended, among other things, that the DFO identify areas of needed research to understand the potential effects of an expanded salmon industry, and that it assign research priorities to ensure the most effective use of limited resources within the time period remaining before new farm site proposals are reviewed.

In New Brunswick, the province is in the process of reviewing applications as part of its site allocation policy for the Bay of Fundy that was announced in October 2000. The policy: focuses on Bay Management Agreements (between growers) that cover issues such as husbandry practices, bio-security and fish health management; includes single-year class management and bay management, the concept of exclusion areas and restricted growth areas; and allows salmon growers already in the industry to either expand their sites or apply for new ones.

In the Canadian context, the subject of siting is primarily, but not exclusively, a matter of provincial responsibility. The DFO's mandate requires it to conserve and protect wild salmon and its habitat, the main vehicle for regulation being the federal *Fisheries Act*. Last year, DFO officials informed the Committee that a legal review team of departmental personnel and staff from the Office of the Commissioner for Aquaculture Development had been established to review environmental regulations, including sections 35 and 36 of the *Fisheries Act*, which environmentalists feared would result in less stringent regulation.[20] Section 35 deals with harmful alteration, disruption or destruction of fish habitat; section 36 prohibits the deposit of deleterious substances in waters frequented by fish. These two sections also provide the basis for the Department's role in reviewing applications and setting conditions for fish farms licences. A

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received full approval by both the provincial and federal agencies to relocate to an approved alternative site.

(20) Where an activity is likely to result in harmful alteration, disruption or destruction of fish habitat or in deposit of a deleterious substance, the Minister is authorized under section 37 of the *Fisheries Act* to request information about planned activities and to require modifications or restrict the proposed activity.

decision by the Minister of Fisheries to authorize the harmful alteration, disruption or destruction of fish habitat triggers an environmental review pursuant to the *Canadian Environmental Assessment Act*, which came into force in January 1995. Another trigger is the *Navigable Waters Protection Act*, under which the DFO assesses proposed aquaculture installations to determine whether they will substantially interfere with navigation.

In the view of industry proponents, existing regulations and decision-making processes impose added delays, expenses and missed opportunities that impede development and job creation. For example, we were told in Nova Scotia that the costs of environmental assessments were $70,000 per site, compared to operations that needed initial capitalization of only $80,000. The following statements illustrate the comments made by federal and provincial government officials on the matter of environmental assessments:

> Many scientists and critics of aquaculture would say that sites should not be approved until all the questions have been answered. They want a modelling of the bay and input/output modelling and answers to all questions on impact. I think a more prudent approach is to proceed slowly and monitor the impact as you go. If no significant environmental effects are noted, perhaps operations can increase. There is a combination of upfront assessment and trying to answer as many questions as you can. We think it is as important to monitor the on-farm and off-farm footprint impacts over time in the real world, as opposed to trying to do all of the science in computer models up front. – Peter Underwood, Deputy Minister, Department of Agriculture and Fisheries, Nova Scotia, *Proceedings,* 15 May 2001.
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> ...
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> While science does not have definitive tools to indicate allowable production on a site nor (does it) provide limits of production for any specific area, we have taken an adaptive management approach (i.e., on-going environmental monitoring with remediation should problems be identified). – Claire LePage, Deputy Minister, Department of Agriculture, Fisheries and Aquaculture, *Brief*, 15 May 2001.
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> If the likelihood of damage is great and the uncertainty is great, we will take a very cautious approach. However, where the likelihood of damage does not seem so great, there might be a possibility of approving a site. ... (W)e will put in place what I have referred to as an adaptive management approach. We will monitor more stringently, look for more information, and seek to eliminate that uncertainty as much as we can as we go forward in partnership with the province and with the proponent. – Liseanne Forand, Assistant Deputy Minister, Policy, DFO, *Proceedings*, 2 May 2001.

In April 2001, the Aquaculture Commissioner's *Legislative and Regulatory Review of Aquaculture in Canada* concluded that an "effective" and "efficient" environmental regime could be developed using the following process:

- Clarify and make existing legal measures more transparent, with respect to sections 35 and 36 of the *Fisheries Act* as applied to aquaculture operations.
- Explore and develop opportunities for industry-led, voluntary, non-regulatory initiatives (e.g., in the areas of fish containment protocols and operational codes of practice).
- Explore and develop class screenings, within the provisions of the *CEAA*, as a means to bring a greater measure of predictability, consistency and timeliness to the environmental process. For each class of environmental projects, a detailed assessment should be conducted, including mitigation measures. Project applications would be reviewed on the basis of the designated report and only site-specific factors would subsequently need to be addressed.
- The concept of a "single window" or coordinated approach to environmental assessment was deemed to have merit, especially if the process is built around a single, comprehensive review procedure covering environmental review and management, site selection and design criteria, operating conditions, compliance standards, and monitoring and reporting requirements.(21)

On "model class screening," the DFO's Commissioner for Aquaculture Development suggests that this would reduce the costs and time needed for the review of applications by governments.(22) A spokesperson for the David Suzuki Foundation categorized the proposed screening process as just another subsidy to industry, and not in the public interest. On the East Coast, the Conservation Council of New Brunswick criticized the DFO for having assumed only an advisory role to the provincial government in siting decisions, and told us that the provincial government had, in some cases, ignored recommendations made by DFO staff against allowing certain sites based on fish habitat considerations. Council spokespersons also criticized the

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(21) Office of the Commissioner for Aquaculture Development, *Legislative and Regulatory Review of Aquaculture in Canada*, DFO Communications Branch, March 2001.

(22) Under the *Canadian Environmental Assessment Act*, a "responsible authority," such as the DFO, can apply to the Environmental Assessment Agency to have a report (or reports) declared as a class screening report for future projects. A class screening report is said to present the accumulated knowledge about the environmental effects of a given class or type of project and identifies the known measures to mitigate those environmental effects. Once approved by the Agency, a class screening report can be used as a model in conducting screenings of other projects within the same class. Such a report is considered acceptable for any class of projects where there is a sound knowledge of the environmental effects and appropriate mitigation measures, such as classes of projects that are routine and repetitive. In applying a class screening report to a project, site-specific circumstances and cumulative environmental effects must be taken into account.

environmental assessment process, which they said did not allow meaningful public involvement and participation. Difficulties in accessing the information about new site proposals were mentioned, making it impossible to judge the veracity of scientific information submitted to government officials by the proponents of projects.

> Over the past few months, we have had our first experience with the (Canadian Environmental Assessment) process, as at least 12 new site applications have been registered for review. Unfortunately, our experience has been disappointing and discouraging. Aquaculture applications are subject to the least rigorous of CEAA's (the *Canadian Environmental Assessment Act*) three possible review procedures, called "screening." Screenings are carried out by the lead federal agency, in this case the DFO. We have found both (the Canadian Environmental Assessment Agency) and DFO to be unwilling to apply the potential of CEAA to address the many public concerns with respect to industry expansion in this area. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, *Proceedings*, 24 April 2001.

D. Environmental Concerns About Salmonid Aquaculture

> *Will (aquaculture) be a totally 100% clean industry? We have pulp mills out there that have limits on them as to what effluents they can put out. If we wanted zero tolerance, we would have to shut them all down in British Columbia. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000*

> *Generally speaking, those (environmental) impacts are already minimal in comparison to many openly tolerated human activities or Canadian industries. ... The legal review I am working on will come up with some clear suggestion on environmental protection regime which will involve a collaboration and a co-operation between the two levels of government. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 22 February 2000*

> *When the Auditor General's team were doing their work one year ago, we were, at the same time, developing the elements of a proposal for a sustainable aquaculture program. Happily, our views of what we needed to do and what investments we needed to make, converged nicely with the comments that the Auditor General provided. – Liseanne Forand, Assistant Deputy Minister, Policy, DFO, Proceedings, 2 May 2001*

The Conservation Council's overriding concern with the aquaculture industry in New Brunswick is the cumulative environmental effect... To date this issue has not been addressed by regulators. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001

I do not think that DFO is a promoter of aquaculture, rather it is essentially an environment department. It no more promotes aquaculture than it promotes the wild fishery... . DFO has conservation and habitat as its primary mandate, and it does that effectively. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001

... (T)he devil is in the detail and in the doing. Thus, we will want to monitor, as Parliament's external auditors, in the years ahead. – Ronald C. Thompson, Assistant Auditor General, International Affairs, Proceedings, 2 May 2001

The environment and fish habitat elicited much heartfelt discussion during our review. Like other forms of intensive animal production (e.g., poultry or hog operations), densely stocked salmonid farms produce wastes. However, unlike terrestrial farming, where the effluent usually reaches natural water bodies indirectly in runoff, the wastes pass through the net-cages and are released directly into the surrounding marine environment. The wastes include uneaten (excess) feed and faecal matter (said to be the bulk of discharges), chemical residues (e.g., antibiotics, pesticides, and anti- foulant paints used to prevent the growth of barnacles and other species), and other wastes (e.g., morts, shed fish scales). The obvious question is what effect this untreated effluent has on water quality and local ecosystems.

The possible consequences of wastes on the ecosystem were said to include the accumulation of sediments on the ocean bottom, decreased oxygen levels, increased algae growth,[23] the absorption of residues by marine life, and the mortality of bottom creatures and plants, especially in areas where there is poor tidal flushing of farm sites, shallow water, and slow currents. In British Columbia, the total quantity of untreated effluent produced by salmon net-cage operations was estimated by witnesses to be approximately equivalent to the amount of

(23) Uneaten fish feed and faecal wastes are a source of nutrient pollution (carbon-based organic matter and nitrogen and phosphorous compounds) that reduces the oxygen content of water and that is unfavourable for both farmed fish and the ecosystem. It is suspected that nutrients released from salmon farms stimulate micro-algal blooms.

human sewage produced by a city of 500,000 people. On the East Coast, fishers were concerned about the possible impact that fish farming could have on lobster stocks.

In British Columbia, industry supporters often pointed to the province's Salmon Aquaculture Review which concluded, in 1997, that salmon farming presented low overall risk to the environment. Others, however, pointed out that since the imposition of the moratorium on new salmon farm leases, the sector had increased by 60% through raising more fish. Many groups and individuals in that province called for the closer monitoring of farm sites and for immediate studies to properly assess their impact. For example, we were told that infestation of sea lice, an ecto-parasite found on the skin of salmonid, are killed using ivermectin, a highly toxic substance that the manufacturer does not recommend for marine applications because of its toxicity to other organisms.

Conservationists and environmentalists in B.C. repeatedly stated that the industry was reluctant or refused to provide information on its activities. Committee members were shown photographs that illustrate some of the other, more visible types of wastes and debris left behind when fish farms cease to operate or move.(24) They were told that the areas beneath salmon farms resembled "moonscapes," and that there had been no studies conducted on the biota in the vicinity of salmon farms before and after they had begun their operations. Spokespersons for the salmon farming sector, on the other hand, asserted that studies had shown that the accumulation of waste (if any) was generally limited to areas directly underneath the farms and does not extend very far beyond them. Later, in April 2000 following our visit to the region, the province announced a salmon aquaculture monitoring program that requires all farms to provide specific data on environmental conditions at and surrounding fish pens to help set environmental standards for future operations.(25)

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(24) In January 2001, provincial fisheries inspectors in B.C. completed their annual cycle of inspections of salmon farms, and found all of them to be in compliance with the requirements of their aquaculture licences. However, in April 2001, a report by the B.C. Ministry of the Environment determined that, as a whole, the salmon farming industry needed to improve its compliance with provincial regulations governing such things as the improper disposal of sewage, net waste, and blood water from on-site fish gutting, as well as failure to keep proper documentation on fish farm practices.

(25) In October 1999, the Government of British Columbia announced that new regulations would be based on strictly enforced environmental standards that stipulate the allowable impact farms may have on the seabed and water quality below and around their net-pens. Under the policy, salmon farmers would be required to conduct routine monitoring of the impacts on the area surrounding their net-pens,

In British Columbia, we learned of a private prosecution launched under the *Fisheries Act* against a salmon farming company (Stolt Sea Farms Inc.) operating off Vancouver Island. The prosecution alleged that the build-up of wastes underneath a salmon farm represented a harmful alteration of fish habitat under the *Fisheries Act*; it also took place at a time when the federal government was dedicating significant effort to the expansion of the industry. The charges were stayed on the grounds that licensing of the site (with knowledge of the effects) would reduce the chances of a conviction.(26)

On both coasts, Committee members were often reminded that salmon growers rely on a healthy environment for their existence, and that every human activity has an environmental or ecological "footprint." In the Atlantic region, one individual observed that fishing methods – such as trawling and dragging in the traditional (wild or capture) fisheries – had affected marine ecosystems more adversely than had aquaculture. While generally acknowledging environmental and fish habitat concerns, proponents of salmon aquaculture emphasized that it was in the farmers' best interest to maintain a healthy and productive aquatic environment for their fish. At current levels of production, they maintained that salmon farming presents a comparatively low ecological or environmental risk when compared to the larger sources of pollution, such as municipal sewage systems.

Last year, DFO officials informed us that a legal review team of departmental personnel and staff from the Office of the Commissioner for Aquaculture Development had been established to review environmental regulations, including section 35 of the *Fisheries Act* (dealing with harmful alteration, disruption or destruction of fish habitat) and section 36 (prohibiting the deposit of deleterious substances in waters frequented by fish). Environmentalists feared that the review, which has since been released to the public, would result in less stringent regulation. On these provisions, the Department was criticized for never having exercised its powers to deny permission to site a fish farm in New Brunswick where it

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and if the impacts exceeded acceptable limits, they would be required to change management practices.

(26) The Auditor General's December 2000 report noted that it was acknowledged that there was evidence of damage to the sea bed below and adjacent to the salmon farm. The individual in question, a former Member of Parliament (Lynn Hunter of the David Suzuki Foundation), explained to the Committee that neither the provincial government nor the DFO had acted upon a 1996-1997 provincial report (obtained through the *Access to Information Act*); the report found that wastes were accumulating and spreading beyond the farm.

might harm fish habitat, or to charge a farm for releasing substances in the environment that are deleterious to fish. The Auditor General's December 2000 report on salmon farming in B.C. similarly noted that no salmon farm had ever been prosecuted for the release of a deleterious substance having an impact on fish habitat. Put simply, industry critics on both coasts asked the federal government to "act in the interests of the public."

The industry put forward a variety of approaches to reduce pollution, such as using feeds with low fish meal content, avoiding overly dense siting of fish farm sites, and siting net-pens in areas with strong currents or tides that flush wastes (a strategy discredited by environmentalists as the "dilution is the solution" approach). More refined feeding schedules and underwater camera systems that monitor the feeding of fish are increasingly being used to ensure that feed (which is the major production cost) is not wasted, and this was said to dramatically reduce the amount of waste at farm sites. Another measure thought to reverse the adverse impacts of salmon farming is fallowing; this involves revolving the growing process so that some net-pens are left empty to allow sediments and the biota under them to recover, much as a land farmer circulates his pastures. However, we were told that there are no clear answers on how long it takes for a fish farm site to recover once an operation ceases, or when and how long sites should be left fallow.

Another concern in our discussions was the control of predators (fish, coastal mammals, and birds) that are attracted to farms because of the potential food sources there. Predators cause economic losses by consuming the stocks being cultivated, or by tearing and creating holes in net-cages which enable the fish to escape. The stocks being reared may be wounded, which reduces their market value and may increase their stress levels, making them more vulnerable to disease. However, lack of information on actual losses makes it difficult to estimate the economic impact. Because fish farmers' desire to control predators by killing them conflicts with the desire of many members of the public to conserve wildlife, fish growers attempt to deter predators through a variety of other practices, such as the use of special netting and other physical barriers, scaring tactics (e.g., dogs, noise makers), electric fences, and trapping.

In British Columbia, underwater acoustic deterrent/harassment devices were introduced in the Broughton Archipelago in order to keep harbour seals away from salmon net-pens. This was said to have contributed to a decline in the abundance of harbour porpoises, and to be the primary cause of the orca whale's avoidance of traditional travel routes in the Archipelago after

1993. Because such devices benefit the finfish farming industry, some witnesses felt that the DFO does not enforce the *Marine Mammal Regulations* under the federal *Fisheries Act*. The impacts of these devices on aquatic mammals are largely unknown because of the paucity of research.

It is noteworthy that the growth in public awareness of environmental issues has resulted in the launch of campaigns to protect global marine resources, and that environmental groups have been able to influence the demand for targeted seafood products (e.g., "dolphin-safe" labels were adopted by producers of canned tuna because of concerns that dolphins were getting caught in tuna nets). A number of organizations are demanding that the public be allowed to choose between products that are safe and friendly to the environment and those that are not. Last year, an "eco-certification" program was suggested to us in B.C. to inform and reassure consumers that the aquaculture products they purchase are grown in an environmentally sound manner, and to give aquaculturists incentives to produce products that can bring higher prices. We learned that standards for seafood were under development by an international organic-certification agency (the Marine Stewardship Council),[27] and that the State of Alaska, which does not allow sea-cage aquaculture, was in the process of getting Alaskan wild salmon classified as organic. Alaskan salmon is reportedly now classified as such, which should be of concern to Canadian salmon producers.

In the Pacific region, the Auditor General's December 2000 report concluded that the DFO was: not fully meeting its legislative obligations under the *Fisheries Act* to protect wild salmon stocks and habitat from the effects of salmon farming; managing on the assumption that salmon farming poses an overall low risk to wild salmon and habitat; and doing little in terms of monitoring salmon farms for effects on wild salmon stocks and habitat.

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(27) Established in February 1997, the Marine Stewardship Council (MSC) is a charitable, not-for-profit, non-governmental, international organization set up to "promote sustainable fisheries and responsible fishing practices world-wide." The Council aims to "develop long-term, market-based solutions which meet the needs and objectives of both the environment and commerce." The MSC's mission is "to work for sustainable marine fisheries by promoting responsible, environmentally appropriate, socially beneficial, and economically viable fisheries practices, while maintaining the biodiversity, productivity and ecological processes of the marine environment." Central to the organization's purpose are its "Principles and Criteria for Sustainable Fishing," against which independent certification companies may certify fisheries on a voluntary basis. Certified stakeholders are eligible to use the MSC logo so as to assure consumers that the fishery products they purchase come from well-managed and sustainable fisheries.

The Auditor recommended that the Department: act immediately to strengthen its monitoring and enforcement capabilities for salmon farming operations; take immediate action to determine how section 35 of the *Fisheries Act* will be applied to salmon farming and how section 36[28] will be addressed; and provide the province with comprehensive comments on potential conflicts between the federal statute and provincial regulations that, at the time of the audit, were being developed.[29] With respect to the *Canadian Environmental Assessment Act*, which requires that every screening of a project consider its cumulative environmental effects, the Auditor concluded that the DFO had no formal plan for assessing the potential cumulative environmental effects of proposals for new salmon sites in B.C. (should the decision be made to expand the industry), and that the potential cumulative environmental effects of multiple salmon farm proposals warrant a public review before a decision is made to lift the moratorium. Witnesses indicated that the Auditor General's December 2000 remarks on the DFO's regulatory performance in B.C. would also ring true in the Province of New Brunswick.

Put simply, on the environmental consequences and risks associated with salmon farms, science is inconclusive because there have been very few studies on the subject.

E. Escaping Farmed Salmonids

> *I just want to make sure it's clearly understood that I'm not saying that right now ... Atlantic salmon populations are establishing in B.C. I'm just saying that if it does happen one day, there are some solutions to that problem. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings of the House of Commons Committee on Fisheries and Oceans, 22 February 2000*

> *Clearly DFO has been pushing a "don't worry, be happy" line while trying to minimize or ignore the very real potential for Atlantic salmon to take over the habitat of wild salmon. – Laurie MacBride, Georgia Strait Alliance, Brief, 22 February 2000*

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(28) Responsibility for administering section 36 of the *Fisheries Act* (dealing with deleterious substances) has been delegated to Environment Canada, under the terms of a 1985 Fisheries and Oceans/Environment Canada Memorandum of Understanding.

(29) The report noted that there is potential conflict between B.C.'s planned performance-based standards and section 35 of the federal *Fisheries Act*, and that the DFO had not yet provided information on how it would determine the administrative criteria for sections 35 and 36 of the Act. In May 2001, Committee members were informed that the B.C. Ministry of Environment, Lands and Parks was developing performance-based standards under its *Waste Management Act* to regulate fish farm wastes in consultation with industry and the DFO.

> *We need to focus our attention on the issues of research and development so that we can provide and achieve the level of commercially viable containment where there is a minimal risk of any escapes and an understanding of what would happen if there were escapes and how we can mitigate against that. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 8 February 2000*

> *The (wild) fish are being "swamped" ... at a time when their populations are least able to cope with it. There is evidence that introduction of inappropriate genes through interbreeding between farmed and wild fish is contributing to the decline in wild populations. – The Atlantic Salmon Federation, Brief, 29 February 2000*

> *(I)n the Bay of Fundy, the Atlantic salmon is virtually reduced to a handful. We are really counting those Atlantic salmon on our fingers and toes. – Inka Milewski, President, Policy, Conservation Council of New Brunswick, Proceedings, 24 April 2001*

> *Aquaculture escaped Atlantic salmon are capable of spawning in B.C. streams. We have shown this to be true beyond any shadow of a doubt. Although the aquaculture fish do not spawn quite as vigorously as we might expect wild Atlantic salmon to, they will spawn and produce viable offspring. ... Once the genie is out of the bottle, there is no turning back... – John Volpe, Department of Biology, Centre for Environmental Health, University of Victoria, Proceedings, 9 May 2001*

A great deal of debate arose over another form of contamination, sometimes referred to as "biological pollution." Biological pollutants are non-chemical and result from the deliberate or accidental introduction of non-indigenous (or "exotic") species into ecosystems where they were not previously present. They can seriously disrupt ecosystems by consuming native species, infecting them with pathogens or parasites, competing with them for space, or by mating with them and changing the gene pool (i.e., producing hybrids). In Canada, a number of non-indigenous species of fish and shellfish are now farmed, including steelhead (or rainbow) trout on the Atlantic Coast, and Atlantic salmon on the West Coast.[30] On the potential effects

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(30) Environmentalists sometimes use the term "smart pollution" because alien species may proliferate and spread, compared to chemical pollution which does not reproduce and which dissipates over time. If they become established in their new surroundings, there are many possible scenarios. New predator-prey relationships may be created, which may drive away native species or even wipe them out. The new dominant populations may also go unchecked and quickly explode. There are many past examples of damage caused by such species (e.g., the zebra mussel).

of escaped farmed salmon on wild stocks, critics charged that the DFO had been avoiding the issue, which they portrayed as being the most devastating threat facing wild populations today.

Wild stocks of salmon are characterized by a large number of genetically distinct populations that are adapted to the specific conditions of the local river systems in which they were born and to which they return to spawn. British Columbia has more than 5,000 genetically diverse Pacific salmon stocks, and the Maritime provinces have more than 150 rivers supporting Atlantic salmon. In contrast, farmed salmon are bred to be genetically uniform and to have favourable production characteristics, such as rapid growth and low aggressiveness. "Selection pressures" in a cultured environment were said to result in "domesticated" fish. However, others asserted that there is very little genetic variation among different strains of Atlantic salmon.

Because salmon are reared in sea-cages, large numbers escape from their enclosures for a variety of reasons: damage due to storms, ice or predators, vandalism, accidents during transportation, improper upkeep of nets, and other avoidable human errors. Moreover, some escapes may go unreported because of the difficulty in verifying how many fish have escaped, and because it may not be worthwhile for fish farm operators to make insurance claims for small numbers of escaped fish. Fish may be lost through frequent small-scale escapes known as "leakage," which is said to go largely unreported. "Escape events" (as they are called) sometimes result in tens of thousands of farmed fish "getting loose" into the ecosystem. Critics of the finfish net-cage industry told us that such escapes are unavoidable in open-water pens, and that without a dramatic improvement in containment capabilities, the number of escapees will increase if the industry maintains its current rate of growth. We were told that public concern about escaped fish is growing in countries that practise salmon aquaculture. According to one DFO report, "monitoring on 30 Norwegian rivers in 1997 indicated that all but four had farmed fish present and the samples collectively on those rivers were composed of 29% farmed fish."[31]

In the Bay of Fundy–Gulf of Maine region, where wild Atlantic salmon populations are in a precarious state, the numbers of escapees are often large in comparison to the small numbers of wild fish. In February 2001, an Expert Panel of the Royal Society of Canada reported that in the only Canadian river for which annual data on escaped cultured fish and wild fish exist (the Magaguadavic River, New Brunswick), the number of cultured fish entering it between 1992 and

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(31) DFO, *Interaction Between Wild and Farmed Salmon in the Maritime Provinces*, DFO Maritimes Regional Habitat Status Report 99/E.

1999 had been two to eight times that of the wild salmon returning to the same river to spawn.[32] In our discussions, salmon aquaculture was said to pose a number of challenges to the recovery of wild salmon because, when strains of domesticated farmed salmon escape and interbreed with wild stocks, the new combinations of genes result in the weakening of the gene pool and the fitness of the remaining wild fish.[33]

Although the causes of the decline in wild Atlantic salmon are uncertain, it was speculated that escaped farmed salmon may have accentuated the deterioration in wild salmon runs because the depletions had occurred in areas where there had been dramatic increases in farmed production. Supporters of the industry responded that this view was unsupported by scientific evidence, and that other factors were affecting the survival of wild fish, including lost habitat, pollution, predation, harvesting outside the 200-mile limit, and global warming. They also emphasized that only local strains of salmon are allowed to be reared on the East Coast,[34] and pointed out that it was in the fish farmers' own economic interest to reduce the risk of escapes.

On the East Coast, we were informed that the North Atlantic Salmon Conservation Organization (NASCO)[35] had recently agreed on guiding principles for developing codes of containment for farmed Atlantic salmon. These codes are to be applied throughout the NASCO Convention area, and are expected to address the prevention of escaped cultured fish by such means as establishing manufacturing standards for nets, cages, moorings, systems inspections, and handling standards. The aim is to create a level playing field in the competitive salmon

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(32) Expert Panel of the Committee on Expert Panels of the Royal Society of Canada, *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada,* February 2001. Escapees can be identified on the basis of body shape, fin erosion, and by the growth patterns on scales.

(33) Last year, Committee members learned that the Atlantic Salmon Federation and Trout Unlimited had filed a lawsuit in 1999 seeking emergency listing for wild salmon in Maine because of the threat posed by the use of European strains. Salmon in Maine rivers were listed under the *Endangered Species Act* in November 2000. In early May 2001, the Committee on the Status of Endangered Wildlife in Canada decided that the wild Atlantic salmon in 33 inner Bay of Fundy rivers needed endangered species listing. The rivers include all those east of the St. John River in New Brunswick and east of Digby in Nova Scotia.

(34) Proponents also argued that, to be competitive, growers be allowed to use the best performing strains of finfish for local rearing conditions. See for example, *Proceedings of the Standing Senate Committee on Fisheries*, 4 October 2000. The preferred stock for commercial production was said to be from the Saint John River.

(35) Canada has promoted the establishment of a North Atlantic NASCO-Aquaculture Liaison Group aimed at facilitating exchanges between wild and salmon aquaculture interests and dedicated to specific initiatives, including the development of a physical code of containment.

farming industry. Access to non-local strains of salmon (e.g., from Europe) has not been permitted under NASCO Protocols between the United States and Canada since the early 1990s; however, it was reported to us that (prior to their signing) the State of Maine had imported strains of Norwegian Atlantic salmon because of their faster rates of growth. With the adoption of the Protocols, Canada had expected the United States to eliminate the use of these, but, despite pressure by Canada, this had not happened. As well, it was reported to us that the aquaculture industry in Maine has taken advantage of a legal loophole that permits the importation of milt from non-American (European) sources.(36) Obviously, those fish are escaping too.

In British Columbia, where both Atlantic and Pacific salmon are farmed, the risks posed by escaped Atlantic salmon were the most contentious.(37) The numbers of Atlantic salmon that escape are reported to have averaged about 43,900 fish per year between 1994 and 1998, and anywhere between 32,000 to 86,000 farmed Atlantics escaped from net-pens between January and September 2000.(38) Atlantic salmon, which represents about 85% of the province's salmonid production, is a species imported from the East Coast and elsewhere because the fish are considered to be more resistant to certain diseases, have a lower mortality rate, are more tolerant to a higher density of fish, have a more favourable feed conversion rate, grow more quickly than Pacific salmon, and have an established market.(39) Last year, conservationists

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(36) The importation of European salmon eggs and live fish is not permitted under current United States law. The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Letter to the Chair, 4 July 2000.

(37) B.C.'s October 1999 policy includes the implementation of approved escape prevention and recovery programs on all salmon farms, licence suspension or cancellation for any repeated failure to comply with escape prevention requirements, enhanced monitoring and the requirement that all escapes be reported, and the development of an escapes protocol with the State of Washington. In response to two major fish escapes, B.C.'s Minister of Agriculture, Food and Fisheries announced, on 23 August 2000, that all salmon farming operations would be required to provide interim (mandatory) escape management plans within 60 days, and that federal research and development funds under the Program for Sustainable Aquaculture (announced by the Minister of the DFO on 8 August 2000) would be sought. Provincial ministry staff were also directed to: begin random audits of escape prevention procedures in all aquaculture operations; expand the scope of stream surveys looking for Atlantic salmon in cooperation with the industry and the DFO; and pursue, with their counterparts in Washington State, joint action to prevent the further losses of farmed fish.

(38) Expert Panel of the Committee on Expert Panels of the Royal Society of Canada, *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada,* February 2001.

(39) For escaped farmed Pacific salmon in B.C., the risk associated with predation and competition was essentially the same as that mentioned for escaped Atlantic salmon. Another concern was the potential interbreeding of farmed Pacific salmon with wild Pacific stocks, leading to the reduced genetic diversity and reproductive fitness of wild stocks. It was also brought to our attention that the province has had a long history of large-scale, government-sponsored salmon enhancement that had already resulted in ecological and genetic interactions with wild salmon. Hatcheries are problematic because the selective survival of large numbers of young from small numbers of adults that donate eggs and milt changes the genetic pool of the wild population.

frequently pointed out to us that the decision to allow Atlantic salmon net-pen culture in B.C. had been made without proper study of its environmental impact. One fear was that escaped Atlantic salmon might one day cross-breed with wild Pacific stocks – a risk assessed by the aquaculture sector to be extremely low.

Another worry was the possibility of escaped Atlantic salmon feeding on Pacific stocks, out-competing them for food, disrupting spawning sites, and becoming established in the wild. Others assessed the risk of such colonization to be low given that several past government attempts to deliberately establish Atlantics for sport fishing along the coast in the early 1900s had failed. In fact, proponents of the industry portrayed the issue as the proverbial "red herring" of salmon aquaculture; the reason usually given was that, compared to Pacific salmon, Atlantic salmon are very poor competitors. One submission put it this way: "The Atlantic salmon is not a starling in Pacific waters but rather a banana plant in Stanley Park. And like a banana plant in Stanley Park, the Atlantic salmon is neither a threat to biodiversity ... and neither (will) it displace native species."[40]

Recent scientific evidence, however, suggests otherwise because Atlantic salmon are present in a number of B.C. salmon spawning streams at all life history stages. Last year, we learned that surveys of 1% of the potential rearing habitat for Atlantic salmon on Vancouver Island had shown the presence of juvenile Atlantic salmon in three rivers (the Tsitika and Adams rivers, and Amor de Cosmos Creek); this indicated that Atlantic salmon escapees were successfully spawning in rivers. At the time, we were surprised to find out that so little study was being undertaken in this area (see Table 3): the only research being done on the ecological effects of escaped Atlantic salmon was by a doctoral candidate at the University of Victoria (an expert in invasive ecology) who explained that a previously reliable method for detecting the presence of Atlantic salmon (electroshock fishing) had been ineffective. He asserted that if you look for Atlantic salmon, "you find them." As of May 2001, John Volpe's work remains the only scientific evaluation of potential ecological effects of Atlantic salmon farming in British Columbia.

With regard to past attempts, in the past century, to establish Atlantic salmon on the West Coast, it was explained to us that these were unsuccessful because the industry used eggs and alevins, unlike Atlantic salmon that now escape which may be fully or mostly grown and have a

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(40) Dr. Brad Hicks, *Brief*, 31 March 2000.

better chance of successfully colonizing. Current escapees may also be acclimatized to local conditions, given that they may be the offspring of generations of parents raised in the Pacific environment. As well, compared to the situation 100 years ago, the depressed state of native pacific salmonid populations, particularly steelhead trout, has left a vacant niche for feral Atlantics, which are capable of persisting in B.C. streams, adversely affecting native salmonids through competition for food and space. We were warned that an expanded industry would result in more escapes of Atlantic salmon – a species now found as far away as the Bering sea. In Alaska, where net-cage salmon farming was banned in 1990,[41] we were told that the Department of Fish and Game had evidence that farmed Atlantic salmon were establishing themselves in Alaskan waters.

Table 3
Status of Knowledge / Information Gaps on the Interactions Between Atlantic and Pacific Salmon
(Either recently escaped or wild spawned)

Area of Concern	Has it been examined?	Has it been demonstrated/ documented?	What is the potential for impact on wild Pacific stocks?
Marine			
Competition for food	No	No	Unknown
Interference/disruption of migration	No	No	Relatively low risk
Attraction of wild salmon to net-cage sites (both lighted and not lighted)	No	No	Possible interruption of seaward or adult return migration patterns
Freshwater			
Interference with spawning (behavioural or egg consumption)	No	No	Risk is anticipated, but magnitude is unknown
Pacific salmon eggs dug up by spawning Atlantic salmon	No	No	Risk is anticipated, but magnitude is unknown
Competition between juveniles for food and space	Yes	Yes	Potentially high; needs to be evaluated
Habitat displacement in freshwater among juveniles	Yes – in laboratory	Yes, but appropriate controls lacking	Risk is anticipated, but magnitude is unknown

Source: Auditor General of Canada, Chapter 30; *Fisheries and Oceans: The Effects of Salmon Farming in British Columbia on the Management of Wild Salmon Stocks*, December 2000; Continuing Studies in Science at Simon Fraser University, *Salmon Workshop Proceedings – Aquaculture and the Protection of Wild Salmon*, July 2000.

(41) Since the early 1970s, the State of Alaska has practised salmon enhancement (also known as "ocean ranching") resulting in significant numbers of hatchery-produced Pacific salmon.

In the Pacific region, Atlantic Salmon Watch (ASW) – a joint federal-provincial program initiated in 1991 – is the only dedicated program that monitors and documents reported sightings of Atlantic salmon. Since its inception, the Province has been the principal funding agency, with staff and facilities provided by the DFO. Last year, in February 2000, testifying before the Committee, the Commissioner of Aquaculture Development said that rivers in British Columbia were "monitored very closely." In December 2000, the Auditor General recommended that the DFO expand and improve the ASW to provide the information necessary to assess the effectiveness of its regulatory and management activities. However, it was brought to our attention that the number of Atlantic salmon in the wild are underestimated because much of the information generated by ASW comes from reports of Atlantic salmon taken in commercial catches. The reports are marginally informative because they reflect fishing effort and the seasonality of fishing (e.g., if fishing is curtailed, interceptions of Atlantic salmon are also curtailed). Also, reporting is voluntary and compliance is unknown.(42) To date, their presence has been documented in 77 rivers in British Columbia.

The following statement conveys the general nature and tone of our discussions with those who had fears about escaping Atlantic salmon in B.C:

> Atlantic escapes have defied every prediction (the) DFO has made about them to date: at various times, the Department has assured concerned citizens that Atlantics wouldn't know how to forage, they wouldn't know mature to spawning ability, they wouldn't know where to find a river to spawn, they wouldn't know how to avoid being eaten by predators, they wouldn't escape in sufficient numbers to spawn successfully and finally, their spawn would not be viable. – Musgamagw Tsawataineuk Tribal Council, *Brief*, 14 February 2000.

To reiterate, those fears have been substantiated.

Obviously, escapes are not to the advantage of salmon farmers; they are a financial disaster to those who own them. On both coasts, salmon farmers expressed their willingness to co-invest in research and development to minimize the risk of fish escapes. We

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(42) Most of the Atlantic salmon recovered in the marine and freshwater environments were said to be in close proximity to salmon farming rearing areas or facilities. In 2001, the B.C. Ministry of Fisheries secured funding from the B.C. Ministry of Aboriginal Affairs to provide training and employment opportunities for local First Nations in stream survey methodologies to encourage their involvement in the Atlantic Salmon program in their traditional territories.

were told that they had been developing and implementing codes of conduct for salmon farming practices, and that, whether indigenous or non-indigenous species are raised, measures can be taken to minimize escapes and the potential attached risks. For example, fish that have no chance of surviving and reproducing outside captivity may be cultivated.[43] The immediate retrieval of finfish that escape was cited as another means. Under the Canadian Council of Fisheries and Aquaculture Ministers, a Task Group has been developing a national code on deliberate introductions and transfers of aquatic organisms, including a mechanism to arbitrate disputes affecting more than one province or territory. A number of submissions, however, suggested that the simplest way to eliminate escapes of non-indigenous species was closed containment on land-based facilities or not to raise them in the first place. Indeed, some groups will be satisfied only with a zero level of risk associated with the use of non-native species.

F. Fish Health

> *Transfer of disease is an important issue. ... There are speculations, and environmental people put out all sorts of information that they say is conclusive. It is not. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000*

> *The Department acknowledges that it does not have enough information available to assess the risk of disease transfer from farmed salmon to wild (Pacific) stocks. ... This prevents any meaningful assessment of the potential implications on fish health of interaction between wild stocks and farmed salmon. – Report of the Auditor General of Canada to the House of Commons, Chapter30, December 2000*

> *I have no problem with comprehensive labelling, but that is not my mandate; that is not in my area. It is for the Minister of Agriculture and the Canadian Food Inspection Agency with Health Canada to determine the labelling and all that. However, I would support any comprehensive labelling. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 4 April 2000*

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(43) One method available for sterilizing fish is the induction of "triploidity"; triploid salmonids are sterile fish created when two normal female fish (or "diploids," each having two chromosomes) are given hormones to fertilize eggs (without a male). In Newfoundland, triploid fish were used for many years for rainbow (steelhead) trout, a non-native species in that province. However, there are a number of reasons why triploids may not be more widely used in future: techniques for effecting sterility are not 100% effective; costs are involved in screening individual fish; triploid fish experience greater mortality and have a higher incidence of deformity compared to normal fish; and feed conversion ratios are not as economical as those for normal fish.

> *... (T)he controlled environment in which our fish are farmed means that the consumer can have a more enhanced assurance of quality and safety from farmed fish than from wild fish, where the environmental conditions are unknown. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Letter to the Chair, 4 May 2001*

> *(W)e have spent $40 million of taxpayers' money over two years compensating New Brunswick salmon farmers for ordered fish kill because of serious disease problems. Before that there was a serious outbreak of sea lice, which cost the industry tens of millions of dollars. These crises that have occurred along the way are driving change. – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001*

The use of drugs, pesticides and other chemical substances, as well as the transfer of fish diseases between farmed and wild fish and between fish farms, were subjects of considerable debate and of primary concern to both salmon aquaculturists and non-aquaculturists alike. On fish health, the Committee can only skim the surface of what is obviously a highly complex and technical issue that involves several sub-issues.

Salmonids are susceptible to a number of bacterial, viral and fungal diseases, as well as parasites. Disease can be transmitted between fish, by other carriers, or by pathogens that are waterborne and that infect animals in their path. In Canada, marine salmonid farming operations are open net-pens. Compared to natural conditions, the physical stress of such crowding is believed to make finfish more susceptible to illness, or to cause disease to spread rapidly in captive populations once it occurs. As such, finfish farms have been described as disease amplifiers. In some areas, concern was expressed about the collection and disposal of morts (dead fish) from farms and fish processing effluent (blood, viscera) as potential sources of disease transference.

On both the Atlantic and Pacific coasts, advocates of salmon aquaculture made the following arguments: pathogens (bacteria, viruses) are part of the natural world; pathogens are no different in farmed fish than they are in wild fish populations; there is no scientific evidence that diseased farmed fish have had an impact on wild stocks, or *vice versa*; and it is much more

likely that wild fish infect farmed stocks because, unlike natural stocks, farmed fish are monitored for disease and treated. Moreover, while the impact of disease can be estimated in farmed fish, it is difficult to assess for wild stocks. Improvements in fish husbandry – including year-class separation, fallowing, selective breeding for disease resistance, improved nutrition – were also said to have reduced the risk of disease transfer. It was impressed upon us that fish farmers have a strong financial incentive to reduce losses due to disease. In the Atlantic region, where aquaculture strains are derived from local stocks of wild salmon and where the use of European strains is prohibited, it was frequently asserted that farmed fish do not create new diseases. On the West Coast, Committee members were told that, to date, diseases in farmed fish are endemic to the region.

In British Columbia, a major and consistent worry was that farmed Atlantic salmon (a non-native species) could transmit new diseases to indigenous stocks and cause irreversible damage, especially given the very low runs of Pacific salmon in some rivers. One submission suggested that the introduction of diseased Atlantic salmon smolts to the Broughton Archipelago in the 1990s might have resulted in a new strain of the fish disease called furunculosis. Proponents of salmon farming, for their part, responded that there had never been a documented case of disease being brought in from outside the province. They made the following points: under the Atlantic Salmon Importation Policy, Atlantic salmon smolts are not allowed to be imported from overseas; only fertilized eggs or milt from certified sources are allowed into the country; and these imports are limited, held in quarantine, and closely examined before they are introduced to farms. This testimony contradicted those who said that the disinfecting process required for imported salmon eggs treats only the surface of the eggs and does nothing to prevent the vertical transmission of disease (from parent to offspring). The more vocal opponents of sea-cage salmon aquaculture called for a total ban on the importation of Atlantic salmon eggs into the province.[44]

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(44) In October 1999, the Province of British Columbia announced that a fish health code of practice would be developed, including standards for disease prevention, outbreak management, drug use, and disease reporting. A comprehensive fish health database would also be developed, access to information would be improved through an annual fish health report to be published by government, and an interagency fish health committee would be established with federal government participation. The Province informed the Committee in May 2001 that: a draft fish health code of practice was completed in January 2001; Fish Health Management Plan Guidelines would apply to all private and public-sector culture facilities; and all salmon farmers and salmonid enhancement facilities would have to develop a Fish Health Management Plan. The code was said to be undergoing technical

Although not known to be harmful to human beings, one highly contagious viral disease affecting Atlantic farmed salmon on the East Coast is infectious salmon anaemia (ISA) – a flu-like sickness with no known cure that attacks the kidneys of salmon. ISA is believed to be spread by the blood water, mucus, or faeces of diseased fish, or by carriers such as parasitic sea lice, farm personnel or contaminated equipment. First detected on Norwegian salmon farms in 1984, the disease was thought to be specific to that region until the virus started appearing in New Brunswick in 1996. The Committee learned that, in 1998, the government took the radical measure of ordering a slaughter of two million farmed fish to prevent this disease from spreading, and that millions of dollars of public money had been spent to compensate fish growers. Small operators were forced into receivership, so that the larger companies gained greater control of the industry. We were told that, for the first time, in October 1999, ISA had been detected in wild Atlantic salmon in New Brunswick's Magaguadavic River.

Similar outbreaks of ISA have occurred elsewhere, for example in Scotland, Chile and the Faroe Islands. In Norway, the virus ravaged salmon farms in the early 1990s; the overcrowding of fish farms led to new regulations restricting size and concentration. In Scotland, the disease problem was said to be serious enough to force a quarantine of one-quarter of its fish farms.(45) In Britain, in the wake of the "mad-cow disease" outbreak, we heard that the major supermarket chains had stopped buying farmed salmon from Scottish fish farms suspected of or confirmed as having ISA. Considering the magnitude of the economic losses caused by ISA (and other diseases), very little is known about the disease. It is unknown whether ISA is endemic and found in wild fish which then transmit it to farmed fish, or vice versa. Last year, we were told that ISA had been a problem in the Bay of Fundy, yet a few kilometres away, salmon in the State of Maine remained disease-free. As of March 2001, this is no longer the case.

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review, which is expected to be completed by July 2001. Once finalized, a decision on how to enforce the management plans will be determined.

(45) We were told that Scottish officials announced, in November 1999, that the ISA virus had been detected for the first time in several species of wild fish including salmon, trout, eels, and in freshwater fish.

Although ISA has never been detected in B.C., conservationists and environmentalists speculated that it was only a matter of time before there is an outbreak in that province; this is because the disease is found in every country from which Canada imports Atlantic salmon eggs.

Another issue was the use of antibiotics to combat pathogens in farmed finfish, many of which are the same as those used to treat human infections. In salmonid aquaculture, antibiotics are administered by feeding fish medicated feed pellets that are thrown in the water. Critics stated that only a very small percentage of these substances is absorbed by the targeted fish, with the rest sinking below the fish pens where it persists in the marine environment, or is consumed by other fish, especially shellfish; many worried about the residual effects not only on the food chain, but also on human health. It was speculated that the use of antibiotics might one day lead to the development of drug-resistant strains of bacteria (or "super-bugs"). This was said to pose risks not only to the ecosystem, but also to fish farm workers and consumers of farmed salmon. In B.C., we were told that strains of fish disease that are resistant to certain antibiotics are already present in farmed fish. Although farmed salmon are required to undergo a drug removal period before being processed, we were also told that antibiotic residues may be present in some farmed finfish that go to market. Government inspection programs were also said to be severely under-funded, so that only a very small proportion of farmed fish are actually examined. Some foreign producers were said to be exporting products to Canada that may contain residues of substances not permitted in this country.

These assertions were vigorously challenged by industry supporters who painted a much different picture and who argued that the Canadian Food Inspection Agency routinely tests farmed salmon, like any other animals raised for food production, for antibiotics and contaminants, and that, compared to many parts of the world, relatively few therapeutants are legally available for use in Canada. They pointed out that: antibiotic use is less than in any other animal food industry; antibiotics are administered only for short periods (a few days) and in very small amounts to control outbreaks; after their use, there is a strictly regulated and lengthy withdrawal period and testing program; and advances in fish health management and husbandry practices, and in particular the development of vaccines for fish, have contributed to significant reductions in the overall use of antibiotics.

One witness stated the following:

> The Department of Fisheries and Oceans (DFO), Fish Inspection Directorate (now under the Canadian Food Agency) has previously estimated that 1.6% of all feed used in the New Brunswick salmon farming industry is medicated. This figure, which is consistent with figures reported for salmon farming in British Columbia, which have not exceeded 3% in the last five years, represents *perhaps the lowest medicated feed inclusion rate* for food animal production in Canada. ... How do we know that salmon are safe from drug residues? From 1991 to 1996, the DFO Fish Inspection Directorate randomly sampled 1,542 and 1,277 lots of farmed salmon in New Brunswick and British Columbia, respectively. Residues levels detected above Health Canada's maximum residue limit (MRL) were found in only 3.5% of the samples from New Brunswick, and in less than 1% of the samples taken in British Columbia over the entire five year period. In almost all cases where follow-up samples were obtained, residues were below the MRL and no further action was required. Positive samples (residue above the MRL) were most prominent in the early 1990s. Since that time, ... the occurrence of residues above the MRL have been nearly non-existent... – Dr. Myron Roth, VP Production and Regulatory Affairs, Aqua Health Ltd. and President of the Salmon Health Consortium, *Brief*, 22 February 2000.

Industry supporters made the following additional points: research into fish disease is in its infancy; compared to other countries (e.g., Norway, Japan), the number of government-approved chemotherapeutants in Canada is absurdly limited; this limited number of approved products restricts the ability of fish farmers to treat disease effectively once it occurs; and a broader range of products should be available to prevent and manage disease. Moreover, it was stressed that nearly all antimicrobial drugs are administered under the direct supervision of licensed veterinarians.[46] Industry critics, for their part, told us that although the amount of antibiotic used per kilogram of fish raised had decreased, any increase in salmon production will result in an absolute increase in drug use.

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(46) The number of drugs, pest control products, and anaesthetics approved for use for finfish aquaculture in Canada was said to be limited, numbering only eight for food fish such as salmon and trout. Of these eight, four antimicrobials were said to be licensed for use and, of the four, three are prescription-only medicines.

On the subject of disease control, it was also proposed that some form of crop insurance be made available to aquaculturists similar to programs in the agriculture sector. On a land-based farm or ranch, if a disease that is harmful to human beings or to other farms is detected, the infected animals are destroyed and the farmer is compensated for the losses incurred (under the *Health of Animals Act*). In aquaculture, it was explained that government-ordered fish kills also take place as a precautionary measure (even if only a few diseased fish are found). However, private insurance companies will compensate fish farmers for fish killed by disease only and not for healthy fish that are slaughtered as a precaution. It was also argued that crop insurance in the aquaculture sector would help stabilize the industry and make financing easier to obtain. According to one witness, the need for crop insurance was demonstrated in the Bay of Fundy in 1998, when ISA cost the industry over $70 million in direct and foregone opportunity costs. It was estimated that if an agriculture-type crop insurance program for salmon growers had been available at the time, the costs would most likely have been less than $4 million. This estimate is based on the following assumptions: a surveillance system would have been in place; farmers would have been required to report; and a pre-established rapid response would have dealt with the disease quickly.

Although a preventative vaccine has been recently developed for ISA, we were told it had been shown to be ineffective because the virus can lodge in the mucus covering of fish (which is not supplied by blood). At present, ISA (and other diseases) is being controlled by animal husbandry practices, adherence to hygiene and disinfection protocols, stocking and fallowing policies, site monitoring, and fish kills. On 29 May 2001, the Commissioner for Aquaculture Development told Committee members that the DFO was addressing the issues of aquatic animal health, government-ordered eradication of fish, and compensation (recommendations 21 to 24 of phase one of his regulatory and legislative review) through a National Aquatic Animal Health Program.

On the reporting of disease and antibiotic use, a spokesperson for the industry described the situation in the Atlantic and Pacific regions in the following terms:

> There are essentially two systems in play – at least in terms of the salmon industry, if I can use that as an example. In British Columbia, there are regulations that require reporting. The government is involved in managing that issue. ... On the East Coast, that government control is not there, so the industry has implemented what is called a "healthy salmon program," particularly in New Brunswick and Nova Scotia. It essentially mirrors what goes on in British Columbia but in this case it is done by the industry. It is seen to be quite effective. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, *Proceedings*, 1 May 2001.

It is noteworthy that the B.C. Salmon Farmers Association, the New Brunswick Salmon Growers' Association (NBSGA), and other associations have established, or are developing, codes of practice to deal with the disease problem.(47) In New Brunswick, the Department of Agriculture, Fisheries and Aquaculture unveiled a new site allocation policy for the Bay of Fundy in October 2000; the policy focuses on Bay Management Agreements (between farmers) that cover issues such as husbandry practices, bio-security and fish health management, (mandatory) Fish Health Surveillance, and environmental management. Single-year class management and bay management are priorities under the new policy.(48) Other developments in that province include the Healthy Salmon Program (HSP) – a certification program launched by the NBSGA in November 2000 to foster the responsible use of therapeutants, and to serve as a mechanism for farmers to verify their compliance with established federal in-food drug residue tolerances set by Canadian and U.S. regulators. A semi-annual audit (and certification)

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(47) In March 2000, members of the New Brunswick Salmon Growers' Association endorsed a new Code of Practice that sets standards for husbandry practices and fish health management in that province. The code divided the province into Bay Management Areas. Salmon farmers agreed on protocols for disease management, the growing and harvesting of fish, the disinfection and cleaning of equipment, and the handling of waste. A new fish health surveillance program moved the responsibility of regular testing and reporting of fish health data from government to the individual farmer. Compliance with the new code was reportedly tied to the licensing of farm sites. The B.C. Salmon Farmers Association reportedly implemented its own code on 1 January 2000.

(48) To achieve single-year class farming, the Bay of Fundy is to be divided into distinct zones (referred to as Aquaculture Bay Management Areas, or ABMAs), the boundaries of which are based on a combination of oceanographic, fish health, and business considerations. The policy reportedly supports the concept of exclusion areas and restricted growth areas, and allows salmon growers already in the industry to either expand their sites or apply for new ones. The implementation of the policy calls for the collaboration of the Department of the Environment and local government.

procedure includes assessing a farmer's fish health management practices, therapeutic handling, storage and use, as well as record systems for tracking treatments, withdrawal times, and harvest.

The NBSGA also funds (along with the provincial Department of Agriculture, Fisheries and Aquaculture, and the federal Atlantic Canada Opportunities Agency) the Animal/Aquaculture Productivity and Health Information Network (APHIN) – an Internet-based fish health management database run from the Atlantic Veterinary College of the University of P.E.I.[49] As part of B.C.'s October 1999 policy, the B.C. Salmon Farmers Association (BCSFA), in cooperation with the B.C. Ministry of Fisheries and the DFO, is developing a similar Fish Health Database. Information on individual farms will not be accessible because these databases are private-sector initiatives.

Lastly, the general public's growing awareness of the need to reduce the unnecessary use of antibiotics was brought up during our deliberations. Many people may wish to avoid eating or handling farmed salmon that have been so treated, while others may wish to avoid farmed fish because of concerns about the aquaculture industry's impact on wild stocks and the marine environment. The labelling of farmed fish was therefore suggested. At present, this was said to be at the discretion of the industry; because farmed fish is seldom, if ever, labelled as such, consumers are not able to differentiate it from wild fish.

G. Shellfish Aquaculture, Enhancement

> *I commend you for having decided to visit Madeleine Islands during the process of your hearings. Scallop fishermen there decided to do sea ranching. – Yves Bastien, DFO Commissioner for Aquaculture Development, Proceedings, 22 February 2000*

> *Following a trip to Japan in 1989, some people wanted to meet with the fishers to propose another way of doing things, that is, to use aquaculture or mariculture techniques that would allow for the regeneration of fish stocks. That is what I call sea ranching in support of the fishery. – Sylvain Vigneau, Co-ordinator, Association des pêcheurs de pétoncles des Îles-de-la-Madeleine, Proceedings, 29 May 2001*

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(49) Initially a pilot project in 2000 when Committee members first learned of APHIN, the Network gathers (confidential) health records from salmon growers in a computer database, and allows them to compare the productivity and health of their fish with that of other farms in the province. The Atlantic Veterinary College offers a similar program for swine farms in P.E.I. and Ontario.

> *All (that) we experienced leads us to the idea that an integrated approach is essential. In order for the industry to develop, all aspects must be considered and developed in some focused plan. Seed supply, environmental influences, grow-out technologies and efficiencies, processing, product development, distribution, financing, and regulations all must be considered together. – Jennifer Caines, Brief, 5 June 2000*

Salmon farmers and environmental groups have sharp differences of opinion with regard to any future expansion of salmon aquaculture. With respect to shellfish (a sector that has not attracted much media attention), views do not seem to be as deeply divided. The major reason is that shellfish growing is generally considered to be a more environmentally friendly activity than salmon farming, with less of an impact on the ecosystem. Unlike salmon farming, which relies heavily on manufactured feed, shellfish are filter-feeders that consume nutrients already present in the water column. Consequently, there are no problems associated with wastes or residues (e.g., feeds, antibiotics) that enter the marine environment. In this regard, notwithstanding the visual impact of shellfish farms in some areas, shellfish growers do not have the same "public relations challenge" as do salmon farmers. In fact, it has been suggested that the cultivation of shellfish near or on salmon farms could help reduce excess nutrients generated by the latter.

Most finfish farming requires large capital investment which, in many cases, can be undertaken only by individuals and companies with access to substantial financial resources. In shellfish aquaculture, on the other hand, there is a predominance of small and medium-sized businesses and family operations, indicating opportunities for small entrepreneurs. Moreover, the species group is generally very much in demand and highly valued by consumers, and there are no costs associated with feed (a major production cost for finfish) or with escapes, given that shellfish are sedentary animals. Although First Nations in B.C. have at best "mixed feelings" about finfish farming, DFO officials said that they generally support shellfish aquaculture more than salmon aquaculture.

On shellfish, comments on both coasts were made to the effect that the regulatory system was inappropriate for the industry. For example, on the East Coast, Committee members learned

that there are certain market advantages in growing smaller-sized oysters ("cocktail oysters"): revenues can be generated more quickly; production expenses are lower; and the costs associated with mortality are also lower. However, it was explained to us that regulations designed to protect the wild fishery cause unnecessary regulatory problems for shellfish aquaculturists. The product must pass through registered plants for intra-provincial sales, although no similar restriction is applied to large oysters harvested by either the wild fishery or aquaculturists.

In Northern B.C., Committee members heard that opportunities were actively being investigated and planned for oyster and scallop farming. Growers in that province also said that their sector was at a critical juncture in its development. In November 1998, the provincial government introduced the Shellfish Development Initiative, a plan that was expected to double the amount of Crown land available for shellfish aquaculture within a 10-year period. In the first step of the Development Initiative, Aboriginal people obtained tenures. The second stage, announced in April 2000, was the expansion of 66 shellfish farms on Crown foreshore. The next step will be to open up new areas of the coast for shellfish farms. Shellfish growers stated that an expansion of tenures for clams would remove only a small fraction of the total area fished by the traditional (wild) clam fishery, yet would provide a disproportionately larger return in terms of increased production and employment. For example, converting 10% of the ground currently used by the wild fishery to farming would result in at least a tenfold increase in clam production. One witness explained:

> Currently, the industry has a footprint of about 2,000 hectares to produce approximately $12 million of farmed shellfish. That is equivalent in area to the new runway at the Vancouver International Airport. We are talking about doubling that land base in the next 10 years to generate $100 million in revenue. That comes with some other high value species like geoduck and scallops, as well as oysters and clams, with some further intensification of production. However, it is a very small part of the 27,000 kilometres of coastline in British Columbia. I think it is about 0.1% of the total land for tenure. – Sam Bowman, President, B.C. Shellfish Growers Association, *Proceedings*, 30 May 2000.

The following statement sums up much of the frustration of shellfish farmers on both coasts with respect to government regulation:

> I do not think that the industry has a problem with regulation. What is important is that regulation be appropriate for the industry. What has been frustrating is that much of the regulations were originally designed for the wild fishery. As aquaculture comes into development, there is not a place where it naturally fits. Therefore, it has tended to receive the same regulations as the wild fishery, and that does not work for aquaculture. – Ruth Salmon, Executive Director, B.C. Shellfish Growers Association, *Proceedings*, 30 May 2000.

The future growth of the shellfish sector was also said to depend on: access to suitable sites of adequate water quality; consistent seed stock supply; disease prevention; and biotoxin avoidance. Under the Program for Sustainable Development announced in August 2000, the DFO has earmarked $20 million (over five years) to enhance the Canadian Shellfish Sanitation Program (CSSP). This was developed to ensure that: all shellfish growing areas meet approved water quality criteria; sources of pollution are identified; and shellfish sold commercially are harvested and handled in an approved manner. With that goal in mind, the DFO, Environment Canada and the Canadian Food Inspection Agency are to increase their activities in areas such as water testing, fish plant monitoring, the monitoring of shellfish toxins, the management of shellfish harvesting, and the publicizing and patrolling of fish harvesting closures.

On the East Coast, the "enhancement" of shellfish stocks (sometimes referred to as "sea-ranching") shows much promise if growers can secure consistent supplies of seed and be assured of private access to the stocks being reared. Essentially, enhancement comprises activities "in-between" capture fisheries and traditional aquaculture. It involves the collection of juvenile scallops (spat) in the wild, growing them in the collectors, and re-seeding or dispersing them in designated areas where scallop beds have been depleted and where they will be later harvested by scallop fishers. This type of activity was said to have been pioneered in Japan, the world leader in the farming of scallops.

In the Atlantic region, we were made aware of three such projects for scallops. In New Brunswick, the Maritime Fishermen's Union has become involved for the first time in scallop enhancement. Another group in that province has also been promoting the activity in the Strait of Northumberland; however, the project was said to have encountered the opposition of some fishers who perceived it as a threat to the wild scallop fishery. In the Magdalen Islands, on the other hand, we were told that scallop fishers had in fact themselves become aquaculturists of sorts. There, a scallop enhancement enterprise (Pétoncles 2000) has been developed by scallop fishers, the DFO, the provincial department of fisheries, and others to enhance depleted scallop beds and increase commercial catches. The enterprise is a business with capital stock, 60% of which is owned by the fishers, who have the option to purchase quota commensurate with the percentage of the business they own.(50) The cornerstone of the project was said to be the lease they obtained, which gives them the right to access the beds that are being re-stocked. The project was said to be an excellent example of how fishers can increase their incomes by working together. Also, if fishers are able to see the economic benefits of enhancing stocks, they will participate more fully in these types of aquacultural activities (for a more detailed discussion, see *Proceedings of the Standing Senate Committee on Fisheries*, 29 May 2001).

H. Science, Research and Development

> *Expectations are high for aquaculture as an economic engine in coastal areas. However, the industry must be developed in an environmentally responsible way in keeping with the need to protect the aquatic environment and its resources and sustain them for the future. This will require additional science to address gaps in knowledge and address issues and concerns. – Department of Fisheries and Oceans, Estimates 1999-2000: A Report on Plans and Priorities, Science Branch, 1999*

> *Salmon farming has the potential to create additional stress on wild salmon stocks over time, especially if the industry expands. We found that the Department has not developed a plan to evaluate and manage the risks in the long term. – Report of the Auditor General of Canada to the House of Commons, Chapter 30, December 2000*

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(50) Young scallops are captured in their natural habitat (a closed fishing area), left to grow in a protected area (the lagoon at Havre-aux-Maisons), and later re-seeded at five designated sites. To ensure a yearly harvest, the plan is to fish one zone each year, and to re-seed the zone the following year so that, after four years, harvesting can resume again.

Concerning the issues that exist, there are two points of view that are far apart. We need to bring those views to a common point so that we can find out what is right. We hope that science will help us to accomplish this. – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 1 May 2001

They very carefully construct research projects that only give one side of the argument. When there are research projects that have federal support, and they come across evidence that does not support their view of the world, they retrieve their research funds, which is what has happened here again and again. – Lynn Hunter, Fisheries and Aquaculture Specialist, the David Suzuki Foundation, Proceedings, 9 May 2001

A review done by DFO in 1998-99 on this region of Atlantic Canada ... lists 154 research projects. ... The overwhelming majority of the projects ... are in the areas of vaccines, stock development, grow-out techniques, transgenics, disease surveillance, alternative species, and so on. – Inka Milewski, President, Policy, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001

The federal government maintains the lead role in aquaculture research. We were often told in our informal discussions that investment in technological innovations is key to continued improvements in productivity and diversification of the industry, and that there are many opportunities for the application of new technologies. For example, Canadian companies have been investigating alternative uses for farmed fish, such as for blood extracts for medical purposes or the potential development of human insulin.

Among fish growers, the consensus was that research should be oriented towards the needs and problems of the industry, such as the development of less costly farming techniques and improving therapeutants, and that research should be better coordinated among the various universities and government facilities. The current level of resources dedicated to R&D was said to be inadequate. The federal government has since announced (in August 2000) the Program for Sustainable Aquaculture, a component of which is the Collaborative Research & Development Program (ACRDP), which provides $20 million (over five years) for research and development projects that are proposed and jointly funded by private-sector

partners. These projects are to include research on how to: reduce production costs and increase competitiveness; generate knowledge on new species and technological innovation; and develop hatchery and grow-out technology. A national steering committee was created to set national priorities and allocate funding to the regions.

In 2000, as part of the Network of Centres of Excellence, the federal government created AquaNet – a network of universities, private businesses and government agencies with a mandate to promote three main areas of scientific research: "animal production" (including disease resistance among marine organisms, production enhancement, and the development of underutilized species), "environmental integrity," and "social and economic aspects of developing the industry." The federal government has committed $14.4 million, over four years, to the network, which has its administrative centre based at Memorial University in Newfoundland. In September 2000, the Board of Directors of AquaNet approved funding for 27 aquaculture research projects.

There has been a major increase in the growth of aquaculture over the past two decades. However, salmonids account for about 74% of total production and 92% of the industry's value (in 1999). Industry diversification into other species would appear to be promising. On our informal visits to various research facilities, we were made aware of new species that are being reared in pilot-scale projects or being investigated and that show promise for eventual commercial development (e.g., halibut, haddock, sturgeon, various types of flatfishes, and shellfish). Although research programs are currently underway with the support of the government and the private sector, medium- and long-term research funding was considered to be essential for both basic and applied research to respond to the industry's future needs. One concern was the delay in getting decisions on projects and yearly programs.

The second thrust to the Science, Research and Development component of the DFO's Program for Sustainable Aquaculture consists of $12.5 million to be spent, over five years, on environmental and biological science research by the federal government to increase the DFO's capacity in environmental and biological science, such as determining the assimilative capacity of the Bay of Fundy (its ability to absorb wastes). The theme of increasing our understanding of ecosystems and aquaculture's possible impacts was brought home at the Committee's meeting in

St. Andrews in February 2000. Prior to meeting,[51] representatives of five organizations agreed in advance on the major science-based issues to be discussed, and they met again afterwards. The result was a proposal for a collaborative research project on the local ecosystem in the Quoddy region, which was characterized as a depositional environment where wastes accumulate at the bottom of the water.

To deal with a possible expansion of salmon farming, the DFO will need more information. In the Pacific region, the Auditor General's December 2000 report found that the DFO needed research to understand the potential effects of an expanded salmon industry, and that it was not giving adequate attention to prioritizing research requirements to ensure the most effective use of limited resources. According to the Assistant Auditor General who appeared before us, more science and research are essential for six reasons:

> First, science is needed to develop administrative criteria so that we can determine what is harmful alteration, disruption and destruction of fish habitat resulting from salmon farming.
>
> Second, science is needed to help develop regulations and criteria for determining when deleterious substances are a problem and when they are not.
>
> Third, science is needed to establish more credible siting criteria for salmon farms.
>
> Fourth, if the moratorium is lifted and the aquaculture industry does indeed expand, there may be a call at some point for a cumulative environmental assessment under the *Canadian Environmental Assessment Act*. Science is needed to equip the department, and perhaps others, to do such an assessment or series of assessments.
>
> Fifth, research is needed to identify and assess the risks of interaction of farmed Atlantic salmon with wild salmon.
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> Sixth, science is needed to address the potential risks of introducing transgenic salmon into farming. – Ronald C. Thompson, Assistant Auditor General, International Affairs, *Proceedings*, 2 May 2001.

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(51) The DFO Biological Station, the Huntsman Marine Science Centre, the Atlantic Salmon Federation, the New Brunswick Department of Fisheries and Aquaculture, and the New Brunswick Salmon Grower's Association. See Atlantic Salmon Federation, "Senate Committee Considers Aquaculture," *News Release*, 29 February 2000.

To date, programs for Science, Research and Development announced under the Program for Sustainable Development have focused on the industry's needs to improve production and minimize production costs.

In Canada, the preferred method in the grow-out phase of finfish aquaculture is to use open net-cages. This finfish rearing technique offers aquaculturists the advantage of being relatively simple to operate, requires relatively less capital investment than other technologies, and allows for incremental changes in production capacity. However, as earlier noted, there are environmental, ecological and health concerns associated with net-cage aquaculture. Thus, much interest was expressed in so-called "closed systems" (or re-circulating systems), which were portrayed as being the natural progression in the evolution of the industry. A number of presentations suggested that such systems should, or would, eventually replace open net-pen salmon aquaculture.(52) They were said to be already in use for other species or in other countries, or are being developed. In this regard, two types of technologies were described.

The first method consists of floating, closed-wall cages that resemble the fish pens currently in use, but have a waterproof membrane or bag instead of netting. Water is pumped into the cage, filtered and re-circulated, and wastes are removed from the bag and treated.

The second method involves land-based operations in which water is also re-circulated. Described as the safest way to operate a finfish farm, this set-up offers the following advantages: escaped fish would no longer be a problem; less risk of effluent entering the marine environment; little or no risk of transmission of disease between farmed and local species; predator control would no longer a problem; a reduced need for drugs and antibiotics; drug treatment could be contained and other costs would be reduced (e.g., for insurance, governmental regulation); and the rearing environment could be more easily controlled and manipulated so as to maximize production. On both coasts, it was predicted by some that land-based aquaculture would one day be in the forefront of new species development for freshwater and marine aquaculture.

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(52) Offshore technology was also mentioned as a possibility, but one requiring a sizeable investment in the engineering of cage designs.

In June 2000, Committee members visited one such land-based facility in Nova Scotia for the grow-out of halibut, a highly-valued species of groundfish whose market price exceeds that of salmon. The company, Scotia Halibut, is a Canadian-Icelandic joint venture partnership between a group of Canadian investors and the Icelandic company Fiske. Its facility at Wood's Harbour – the only one of its kind in North America – is capable of producing 250 tonnes of high-quality Atlantic halibut per year. We learned that a hatchery was being constructed that would be capable of producing 600,000 juvenile halibut per year, enough to supply 12 similar grow-out sites. The potential for land-based halibut farming was said to be excellent because of the ability to harvest year-round a product that is consistent in size and quality.

With regard to closed and open systems, proponents of salmon aquaculture dismissed "closed systems" as hugely expensive compared to open net-pens. Their relatively high initial capital investment and higher operating costs (e.g., energy costs) come about because large volumes of water must be re-circulated and treated on a daily basis. Although technically feasible, Committee members were told that these systems: require further development; may not be suited to harsh conditions (e.g., the high tides and rough waters of the Bay of Fundy); and their economic feasibility remains to be demonstrated, especially given the realities of the highly competitive global seafood market. Some challenged this last point, claiming that if all of the environmental, ecological, social and regulatory costs of doing business using fish pens were to be weighed against the costs of closed containment, the latter would prove to be quite attractive. This is because salmon aquaculture, as it is currently practised, does not bear the costs its practices impose on the environment and other user groups (e.g., the commercial and sport fisheries, Aboriginal fisheries, marine tourism). Others noted that land-based systems do not resolve the earlier-mentioned "fish meal dilemma."

It is noteworthy that British Columbia's October 1999 policy on aquaculture calls for the development of closed-containment systems (ten new tenures) and other green technology projects.[53] We also learned that the Ministry of Environment, Lands and Parks published a

(53) In October 2000, the B.C. ministers for the Environment and Fisheries announced the approval of four projects involving new aquaculture technologies and husbandry practices, including: alternative feed sources; waste recovery systems; the exclusive use of female fish stocks; and closed containment systems. The four sites involved two First Nations: the Homalco and the Kitasoo Xiaxias. The projects were among the first new salmon farm tenures to be approved in the province since the early 1990s. The granting of new tenures was originally announced by the provincial government in

study that considers re-circulation technologies and a variety of closed-containment production systems,[54] and that a land-based pilot project to assess the commercial viability of the technology had been approved in March 2001.

Lastly on the subject of research and development, the issue of genetically modified organisms (GMOs) – life forms that have been genetically altered by the introduction of new genetic material – has received much attention in the media. Salmon may be genetically engineered to increase disease resistance, improve flesh colour, or accelerate growth.[55] Although Canadian research in the development of so-called "transgenic" fish (or "frankenfish," as they are sometimes called) has been taking place for some time,[56] the Canadian aquaculture industry does not raise such fish or shellfish, nor does it support their use. So far, they have not been approved for use in aquaculture production anywhere in the world, but as the Auditor General recently observed, that situation could change if global opinion endorses their use abroad. Committee members heard that genetically modified salmon are poised to become the first animals to be farmed for human consumption, and that an application for transgenic Atlantic salmon had been filed in the United States in early 2000 by a company (Aqua Bounty farms, a subsidiary of A/F Protein Canada) whose research laboratory is located in Prince Edward Island. The firm has reportedly developed a fish able to grow to market size much faster than natural salmon. The fear is that one day transgenic fish will be farmed in ocean net-cages and escape in the wild and interact with wild fish populations. In February 2001, an Expert Panel of the Royal Society of Canada warned that, if cultivated in future, transgenic Atlantic and Pacific salmon could escape and cross-breed with wild stocks and corrupt their genetic pool.[57] There are also potential consumer health implications.

October 1999 as part of its Salmon Aquaculture Policy framework. The framework included incentives to test closed-containment and other green technologies through the award of five saltwater and five freshwater pilot projects.

(54) G3 Consulting Ltd., *Salmon Waste Management Review and Update*, December 2000. Fish farms in Iceland reportedly use large, land-based rearing tanks that use geothermal water for aquaculture.

(55) Research on transgenic shellfish and aquatic plants is less developed than that on transgenic salmon.

(56) Initial research on transgenic fish in Canada focused on the transfer of an antifreeze protein gene from winter flounder into Atlantic salmon eggs to produce salmon that are able to tolerate sub-zero sea temperatures. However, most aquaculture-related research on transgenic fish has focused on the promotion of growth. The commercial motivation is to reduce the amount of time it takes for fish to reach market size.

(57) Expert Panel of the Committee on Expert Panels of the Royal Society of Canada, *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada*, February 2001. The Expert Panel was created in response to a request from Health Canada, the Canadian Food Inspection Agency, and Environment Canada.

CONCLUDING REMARKS

Let me reassure you that we will explore every avenue to promote and expand this exciting industry in a responsible and environmentally sound way. – The Honourable Herb Dhaliwal, PC, MP, Minister of Fisheries and Oceans, Proceedings, 15 February 2000

'Sustainability' and the 'precautionary approach' are essentially buzz words that will have as many definitions as the number of people sitting around the table. Therefore, these notions are useless in the real life of decision-makers because they do not refer to precise standards, precise objectives or precise deliverables. ... What is really needed is risk assessment, risk management and risk communication. – Yves Bastien, DFO Commissioner for Aquaculture Development, "Conference Summary and a Vision for the Future of Aquaculture," How to Farm the Seas: the Science, Economics and Politics of Aquaculture, Montague, PEI, September 2000

To put it simply, we found at the time of doing the work, that we did not think that the Department had the tools to allow it to engage in a meaningful risk-based approach. – Ronald C. Thompson, Assistant Auditor General, International Affairs, Proceedings, 2 May 2001

Under the Oceans Act (1997), Canada is moving toward a national oceans management approach based on sustainable development, a precautionary approach, and the integration of activities occurring in and impacting on our oceans. – Environment Canada, Ecosystem Approach and Integrated Land Management – A Canadian Contribution to the Land Use Dialogue at the Eighth Session of the United Nations Commission on Sustainable Development, 24 April to 5 May 2000

The spokespeople for the salmon farming industry, including government spokespeople, remain in a state of deep denial that there are any problems at all. They continue to treat criticism as a public relations challenge ... This is a serious impediment to making any real progress for cooperative action. – Lynn Hunter, Fisheries and Aquaculture Specialist, the David Suzuki Foundation, Proceedings, 9 May 2001

Many of the problems that we are dealing with now could have been prevented. Had they been prevented, we would not be operating in a crisis management mode... – Janice Harvey, Director, Marine Conservation Program, Conservation Council of New Brunswick, Proceedings, 24 April 2001

I believe we are at a crossroads ... The question is whether legislators want the industry to grow. Do we want this for Canada or not? – David Rideout, Executive Director, Canadian Aquaculture Industry Alliance, Proceedings, 8 February 2000

Aquaculture promises important economic benefits in many areas of the country. This is especially so in Nova Scotia and Newfoundland, regions where finfish farming is relatively new, and where participants can learn from past mistakes. This is also the case for the farming and enhancement of shellfish, activities that are generally considered to be environmentally friendly and that appear to offer economic opportunities for small entrepreneurs and fishermen alike. The enhancement or "sea ranching" of shellfish, such as scallops, holds the promise of increasing the productivity of indigenous shellfish stocks for commercial fishers in the capture fishery.

The evidence also suggests that if salmonid aquaculture is to expand with the support of the public and other stakeholders in the marine environment, more research will be needed to address their legitimate concerns as well as to put in place the environmental standards needed to properly assess and monitor impacts. Proponents of salmon aquaculture perhaps tend to downplay the environmental risks associated with the activity, and some argue there are none, while critics contend that the industry should bear the burden of proving that there are no adverse consequences. A major problem is the dearth of objective, scientific information on a number of environmental and ecological issues. These include the potential ecological and genetic effects of escaped salmonids on local species, the interaction of fish farms with aquatic mammals and other species, the incidence and transfer of disease in farmed and wild stocks, and the environmental risks associated with the wastes discharged by farms, to name only a few. Without sound scientific knowledge, it is difficult to see how regulatory agencies can set meaningful standards, guidelines and objectives. Without such information, suspicion and distrust of the industry will continue. We recognize the significant progress made by the salmon farming industry in its management practices, and understand that every human activity has an environmental or ecological footprint. The degree of aquaculture' impact, however, is largely unknown.

Last year in our discussions, we were reminded at the Atlantic Veterinary College in Prince Edward Island of observations made by this Committee in a study on fish marketing tabled in Parliament more than a decade ago, in 1989. That report observed that much of the controversy over the effects of fish farms on water quality and the health of wild fish stocks, and over the effects of medicated feeds and other substances used by the finfish industry, was due largely to the lack of comprehensive data and studies.(58) The Committee advised that strong federal responsibility must be accepted, particularly in the areas of preventive veterinary medicine, disease diagnostics, and the monitoring of fish habitats. The questions asked back then still need answers today. Answers are important in the context of the decline of wild salmon in Canada's Pacific and Atlantic regions.

More research will require an investment in additional resources. The amount of incremental funding ($12.5 million over five years, or $2.5 million annually) for environmental and ecological research for the whole of Canada – as was announced in August 2000 under the Program for Sustainable Aquaculture – is less than adequate when compared to the amount of incremental funding for applied R&D (e.g., under the PSA's Aquaculture Collaborative Research and Development) and other activities aimed at promoting the sector's efficiency and competitiveness.

It may be argued that the findings of further research may not provide the answers quickly enough. On reducing risks, a number of submissions that were made to the Committee called on government to invoke the so-called "precautionary approach" (PA), commonly defined as "erring on the side of caution" when dealing with uncertainty. This approach focuses on the degree of certainty of knowledge needed before politicians and authorities can initiate action on possible environmental problems. According to the PA, even when the outcome of an activity is uncertain and scientific evidence is inconclusive, measures should be taken to avoid the potential

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(58) Standing Senate Committee on Fisheries, *The Marketing of Fish in Canada: Report on the East Coast Fisheries*, December 1989.

negative or adverse effects. The approach was succinctly stated in the Rio Declaration from the 1992 United Nations Conference on Environment and Development as follows:

> In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Principle 15).

In the traditional fisheries, the precautionary approach is a concept endorsed by the federal government and is a cornerstone of the *Oceans Act* (Part II, section 30 (c)); it is also incorporated in a number of international commitments and agreements to which Canada is a signatory.(59) The principle was advocated by this Committee in reports on the traditional capture fisheries tabled in 1998, 1995, 1993, and as early as 1989. On aquaculture, in December 2000, the Auditor General concluded that the DFO will need to apply the precautionary approach to salmon aquaculture in British Columbia by: applying new knowledge from ongoing research in the development of new regulations; monitoring and enforcing compliance with new regulations over the long term; and assessing the effectiveness of these regulations in protecting wild salmon.

Lastly, it is incumbent on the DFO to ensure that its policies and decisions on the best use of the marine environment are for the benefit of all Canadians – aquaculturists and non-aquaculturists alike. In this regard, the DFO also has an important role to play in creating an environment in which the fish farming industry and the traditional (wild) fishery, Aboriginal people, conservationists, environmental groups, and other stakeholders can co-exist. This is especially so because of its emerging role in coastal zone management under the *Oceans Act*. The Act provides the Minister of Fisheries and Oceans with the authority to coordinate federal involvement in all oceans-related issues. It also paves the way for the development of a comprehensive "Oceans Strategy" based on the principles of integrated management, shared stewardship, sustainable development, and the precautionary approach.

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(59) For example, Canada is a member of the Food and Agriculture Organization, where precautionary approaches to the management of fisheries and aquaculture are outlined. The Convention on Biological Diversity also incorporates the precautionary principle. The DFO has an obligation to conform to the precautionary approach under the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks, and the North Atlantic Salmon Conservation Organization (NASCO) Agreement on Adoption of a Precautionary Approach.

RECOMMENDATIONS

1. **Given the shared jurisdictional nature of aquaculture in Canada, the Committee recommends that the Government of Canada and the provincial and territorial governments, and other appropriate jurisdictions, increase their efforts to work collaboratively toward clarifying their respective roles and responsibilities in the regulation of the sector.**

2. **The Committee recommends that the Auditor General of Canada undertake a comprehensive audit in the Atlantic region, similar to that conducted last year in the Pacific region, to determine whether the DFO is meeting its legislative obligations under sections 35 and 36 of the *Fisheries Act*, and its obligations under the *Canadian Environmental Assessment Act* when carrying out environmental reviews of aquaculture project proposals.**

3. **The Committee recommends that the Minister of the DFO give due consideration to the Department's legislative mandate for wild fish and fish habitat when responding to recommendations made by the Commissioner for Aquaculture Development.**

4. **The Committee recommends that before the recommendations and action plan outlined in the report of the Commissioner for Aquaculture Development are implemented, those recommendations be the focus of public consultation with all users of aquatic marine resources.**

5. **The Committee recommends, as general principles on siting, that:**

   (a) **the federal government promote the development of the aquaculture industry in those areas where the potential environmental risks are lowest, where there is community acceptance, and where the long-term economic benefits to coastal communities are reasonably assured;**

   (b) **grow-out sites for salmonid fish be prohibited near migratory routes as well as near rivers and streams that support wild salmon stocks;**

   (c) **when considering aquaculture lease site applications, government develop policies and measures to ensure that the decision-making process is open, transparent and fair. Ideally, local or municipal advisory committees – comprising a balanced cross-section of local interests and stakeholders – should be established to ensure full, meaningful and effective public participation and input in siting decisions; and**

   (d) **the possible economic opportunities of alternative uses of the shoreline be taken into account.**

6. **The Committee recommends that, in developing a national code for sustainable aquaculture, government and industry adhere to the principles and standards for aquaculture set out in Articles 9.1, 9.2, 9.3 and 9.4 of the 1995 United Nations FAO Code of Conduct for Responsible Fisheries.**

7. **The Committee recommends, on a priority basis, that the federal government invest more research resources to:**

   (a) determine the assimilative capacities of aquatic ecosystems in areas and regions where salmonid aquaculture is taking place, or may in future take place. Such research is needed to ensure that the industry remains within ecological limits and that fish habitat and the sustainability of the wild fishery are not compromised. At present, the cumulative impacts of aquaculture on ecosystems where the majority of farmed salmon originates is unknown;

   (b) assess the presence of non-indigenous salmonid populations on both coasts of Canada, and their ecological interactions and impacts;

   (c) determine the probability of disease and parasite transfer between cultured salmon and wild fish;

   (d) determine the uptake in the food chain of therapeutants and other substances found beneath or near salmonid net-cage sites; and

   (e) reduce the environmental impact of finfish aquaculture, such as the development of new feeds that are environmentally friendly.

8. **The Committee recommends that industry consideration be given to the identification and labelling of aquaculture products.**

9. **The Committee recommends that the DFO and the Department's provincial counterparts support and promote initiatives aimed at enhancing or "sea ranching" indigenous species of shellfish, such as scallops. The Department should provide the sector with an appropriate and supportive policy and regulatory framework.**

10. **The Committee recommends that, in terms of government financial support, shellfish aquaculture be given high priority.**

11. **The Committee recommends that the federal government fund multi-year research aimed at diversifying the species mix in aquaculture. As the main beneficiary, the aquaculture industry should share in the effort and cost of this research.**

12. **The Committee recommends that the federal government play a leadership role in research and development by supporting and funding initiatives aimed at developing closed containment finfish-rearing technologies, both land-based and in marine waters.**

13. The Committee recommends that the commercial cultivation of genetically modified (transgenic) fish and shellfish for human consumption continue to be prohibited in Canada, and that research on them continue to be restricted to secure, self-contained, land-based facilities.

14. The Committee recommends that the DFO define the "precautionary approach" as it pertains to aquaculture, and issue a written public statement on how the precautionary approach is being applied to the aquaculture sector.

APPENDIX I

FAO Code of Conduct for Responsible Fisheries, Article 9 – Aquaculture Development

Article 9 – Aquaculture Development

9.1 Responsible development of aquaculture, including culture-based fisheries, in areas under national jurisdiction

9.1.1 States should establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture.

9.1.2 States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information.

9.1.3 States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.

9.1.4 States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.

9.1.5 States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities.

9.2 Responsible development of aquaculture including culture-based fisheries within transboundary aquatic ecosystems

9.2.1 States should protect transboundary aquatic ecosystems by supporting responsible aquaculture practices within their national jurisdiction and by cooperation in the promotion of sustainable aquaculture practices.

9.2.2 States should, with due respect to their neighbouring States, and in accordance with international law, ensure responsible choice of species, siting and management of aquaculture activities which could affect transboundary aquatic ecosystems.

9.2.3 States should consult with their neighbouring States, as appropriate, before introducing non-indigenous species into transboundary aquatic ecosystems.

9.2.4 States should establish appropriate mechanisms, such as databases and information networks to collect, share and disseminate data related to their aquaculture activities to facilitate cooperation on planning for aquaculture development at the national, subregional, regional and global level.

9.2.5 States should cooperate in the development of appropriate mechanisms, when required, to monitor the impacts of inputs used in aquaculture.

9.3 Use of aquatic genetic resources for the purposes of aquaculture including culture-based fisheries

9.3.1 States should conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management. In particular, efforts should be undertaken to minimize the harmful effects of introducing non-native species or genetically altered stocks used for aquaculture including culture-based fisheries into waters, especially where there is a significant potential for the spread of such non-native species or genetically altered stocks into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should, whenever possible, promote steps to minimize adverse genetic, disease and other effects of escaped farmed fish on wild stocks.

9.3.2 States should cooperate in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms.

9.3.3 States should, in order to minimize risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect.

9.3.4 States should promote the use of appropriate procedures for the selection of broodstock and the production of eggs, larvae and fry.

9.3.5 States should, where appropriate, promote research and, when feasible, the development of culture techniques for endangered species to protect, rehabilitate and enhance their stocks, taking into account the critical need to conserve genetic diversity of endangered species.

9.4 Responsible aquaculture at the production level

9.4.1 States should promote responsible aquaculture practices in support of rural communities, producer organizations and fish farmers.

9.4.2 States should promote active participation of fishfarmers and their communities in the development of responsible aquaculture management practices.

9.4.3 States should promote efforts which improve selection and use of appropriate feeds, feed additives and fertilizers, including manures.

9.4.4 States should promote effective farm and fish health management practices favouring hygienic measures and vaccines. Safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals should be ensured.

9.4.5 States should regulate the use of chemical inputs in aquaculture which are hazardous to human health and the environment.

9.4.6 States should require that the disposal of wastes such as offal, sludge, dead or diseased fish, excess veterinary drugs and other hazardous chemical inputs does not constitute a hazard to human health and the environment.

9.4.7 States should ensure the food safety of aquaculture products and promote efforts which maintain product quality and improve their value through particular care before and during harvesting and on-site processing and in storage and transport of the products.

APPENDIX II

WITNESSES

Date	Name
37th Parliament – 1st Session	
April 24, 2001	**From the Conservation Council of New Brunswick:** **(By VIDEO-CONFERENCE)** Ms. Inka Milewski, Vice President, Policy; Ms. Janice Harvey, Director, Marine Conservation Program.
May 1, 2001	**From the Canadian Aquaculture Industry Alliance:** Mr. David Rideout, Executive Director.
May 2, 2001	**From the Office of the Auditor General of Canada:** Mr. Ronald C. Thompson, Assistant Auditor General, International Affairs; Mr. Gerry Chu, Director, Audit Operations Branch; Mr. John Sokolowski, Senior Auditor, Audit Operations Branch. **From the Department of Fisheries and Oceans:** Ms. Liseanne Forand, Assistant Deputy Minister, Policy; Mr. Paul Cuillerier, Director General, Habitat Management and Environmental Science; Ms. Iola Price, Director, Aquaculture Science Branch, Oceans and Aquaculture Science Directorate.
May 9, 2001	**From the David Suzuki Foundation:** **(By VIDEO-CONFERENCE)** Ms. Lynn Hunter, Fisheries and Aquaculture Specialist. **From the University of Victoria:** **(By VIDEO-CONFERENCE)** Dr. John Volpe, Department of Biology, Centre for Environmental Health. **From the Kwakuitl Territorial Fisheries Commission:** **(By VIDEO-CONFERENCE)** Mr. Pat Alfred, President

May 15, 2001	**From the Department of Agriculture and Fisheries - Nova Scotia:** Mr. Peter Underwood, Deputy Minister.
May 29, 2001	**From the Association des pêcheurs de pétoncles des Îles:** Mr. Sylvain Vigneau **From the Department of Fisheries and Oceans** Mr. Yves Bastien, Commissioner for Aquaculture Development Mr. Jack Taylor, Executive Director, Office of the Commissioner for Aquaculture Development

APPENDIX III

WITNESSES

Date	Name
36th Parliament – 2nd Session	
February 8, 2000	**From the Canadian Aquaculture Industry Alliance:** Mr. David Rideout, Executive Director.
February 15, 2000	**From the Department of Fisheries and Oceans:** The Honourable Herb Dhaliwal, P.C., M.P. Minister of Fisheries and Oceans; Mr. Jack Stagg, Associate Deputy Minister; Ms. Liseanne Forand, Assistant Deputy Minister, Policy; Mr. David Bevan, Acting Assistant Deputy Minister, Fisheries Management; and Ms. Iola Price, Acting Director General, Science Sector, Fisheries and Oceans Science Directorate.
February 22, 2000	**From the Department of Fisheries and Oceans:** Mr. Yves Bastien Commissioner for Aquaculture Development; and Mr. Jack Taylor, Acting Executive Director, Office of the Commissioner for Aquaculture Development. **From Aqua Health Ltd.:** Dr. Myron Roth, Vice-President, Production and Regulatory Affairs.
March 21, 2000	**From the Department of Fisheries and Oceans:** Mr. David Bevan, Director General, Resource Management; Mr. Lorne Anderson, A/Director General, Aquaculture Restructuring Adjustment; Mr. Micheal Edwards, Senior Advisor, Aquaculture; Ms. Susan Farlinger, A/Director, Aboriginal Fisheries, Pacific Region. **From the Department of Fisheries and Oceans:** **(By VIDEO-CONFERENCE)** Mr. Paul Macgillivray, Regional Director, Fisheries Management; Mr. Ted Perry, A/Director, Policy; and Mr. Steve Samis, Chief, Water Quality Unit.

April 4, 2000	**From the Department of Fisheries and Oceans:** The Honourable Herb Dhaliwal, P.C., M.P. Minister of Fisheries and Oceans; Mr. Jack Stagg, Associate Deputy Minister; Mr. Michel Leclerc, Special Advisor, Aquaculture, Policy Sector; Dr. John Davis, Assistant Deputy Minister, Science; and Mr. David Bevan Director General, Resource Management Directorate, Fisheries Management.
May 30, 2000	**From the B.C. Shellfish Growers Association:** **(By VIDEO-CONFERENCE)** Mr. Sam Bowman, President; and Ms. Ruth Salmon, Executive Director.
June 13, 2000	**From the Sport Fishing Advisory Board:** **(By VIDEO-CONFERENCE)** Mr. Jeremy Maynard, Chairman. **From the Sport Fishing Institute of B.C.:** **(By VIDEO-CONFERENCE)** Mr. Tom Bird, Executive Director. **From the B.C. Wildlife Federation:** **(By VIDEO-CONFERENCE)** Mr. Wayne Harling, Chair, Saltwater Fisheries Committee. **From Alberni Valley Sport Fishing Association:** **(By VIDEO-CONFERENCE)** Ms. Marilyn Murphy, Secretary.

APPENDIX IV

EXHIBITS

37th Parliament – 1st Session

Exhibit #3:	Department of Fisheries and Oceans, Ottawa, ON
Exhibit #4-10:	Conservation Council of New Brunswick, Fredericton, NB
Exhibit #12:	Professor Richard Moccia, Co-ordinator, Aquaculture Program, University of Guelph, Guelph, ON
Exhibit #13:	Canadian Aquaculture Industry Alliance, Ottawa, ON
Exhibit #14:	The Office of the Auditor General of Canada, Ottawa, ON
Exhibit #15:	Department of Fisheries and Oceans, Ottawa, ON
Exhibit #17:	The David Suzuki Foundation, Vancouver, BC
Exhibit #18:	Dr. John Volpe, University of Victoria, Victoria, BC
Exhibit #19:	Nova Scotia Department of Agriculture and Fisheries, Halifax, NS
Exhibit #20:	British Columbia Ministry of Fisheries, Victoria, BC
Exhibit #21:	Canadian Aquaculture Industry Alliance, Ottawa, ON
Exhibit #22:	Association des pêcheurs de pétoncles des Îles, Cap-de-la-Madeleine, QC
Exhibit #23	Department of Fisheries and Oceans, Ottawa, ON

APPENDIX V

EXHIBITS

36th Parliament – 2nd Session

Exhibit #1:	Canadian Aquaculture Industry Alliance, Ottawa, ON
Exhibit #2:	Department of Fisheries and Oceans, Ottawa, ON
Exhibit #3:	New Brunswick Aboriginal Peoples Council, Fredericton, NB
Exhibit #4:	Commissioner for Aquaculture Development, Department of Fisheries and Oceans, Ottawa, ON
Exhibit #5:	Aqua Health Ltd., Ottawa, ON
Exhibit #6:	St. Andrew's Biological Station, Department of Fisheries and Oceans, St. Andrews, NB
Exhibit #7:	New Brunswick Department of Fisheries and Aquaculture, Fredericton, NB
Exhibit #8:	Huntsman Marine Science Centre, St. Andrews, NB
Exhibit #9:	Jail Island Salmon, St. George, NB
Exhibit #10:	Atlantic Salmon Federation, St. Andrews, NB
Exhibit #11:	Botsford Professional Fishermen's Association Inc., Murray Corner, NB
Exhibit #12:	Maritime Fishermen's Union, Shediac, NB
Exhibit #13:	New Brunswick Salmon Growers' Association, St. George, NB
Exhibit #14:	Department of Fisheries and Oceans, Ottawa, ON
Exhibit #15:	Department of Fisheries and Oceans , Ottawa, ON
Exhibit #16:	Sheena Queen Charlotte Regional Council, Prince Rupert, BC
Exhibit #17:	Marine Stewardship Council, Prince Rupert, BC

Exhibit #18:	Odd Eidsvik , Prince Rubert, BC
Exhibit #19:	Living Ocean Society, Port McNeil, BC
Exhibit #20:	Raincoast Research Society, Port McNeil, BC
Exhibit #21:	British Columbia Salmon Farmers Association, Campbell River, BC
Exhibit #22:	Englewood Packing Col. Ltd., Port McNeil, BC
Exhibit #23:	Kwakiutl Territorial Fisheries Commission, Alert Bay, BC
Exhibit #24:	Musgamaga Tsawataineuk Tribal Council, Alert Bay, BC
Exhibit #25:	Village of Alert Bay, Alert Bay, BC
Exhibit #26:	Gawawaenuk Tribe, Alert Bay, BC
Exhibit #27:	OrcaLab, Alert Bay, BC
Exhibit #28:	B.C. Salmon Farmers Association, Tofino, BC
Exhibit #29:	Regional Aquatic Management Society, Ucluelet, BC
Exhibit #30:	West Coast Sustainability Association, Ucluelet, BC
Exhibit #31:	Nua-chah-nulth Tribal Council, Ucluelet, BC
Exhibit #32:	The David Suzuki Foundation, Duncan, BC
Exhibit #33:	Georgia Strait Alliance, Duncan, BC
Exhibit #34:	Cowichan Regional Fishers' Co-op, Duncan, BC
Exhibit #35:	Alberni Valley Sportfishing Association, Port Alberni, BC
Exhibit #36:	Redl Sports Distributors, Duncan, BC
Exhibit #37:	B.C. Fisheries Survival Coalition, Vancouver, BC
Exhibit #38:	United Fishermen & Allied Workers Union, Vancouver, BC

Exhibit #39:	Taplow Feeds, Vancouver, BC
Exhibit #40:	Native Brotherhood of British Columbia, Vancouver, BC
Exhibit #41:	Karen Wilson, Vancouver, BC
Exhibit #42:	Fisheries Renewal British Columbia, Duncan, BC
Exhibit #43:	Doug Massey, Vancouver, BC
Exhibit #44:	Department of Fisheries and Oceans, Ottawa, ON
Exhibit #45:	Conservation Council of New Brunswick, Fredericton, NB
Exhibit #46:	British Columbia Seafood Alliance, Vancouver, BC
Exhibit #47:	Pacific Trollers' Association, Vancouver, BC
Exhibit #48:	Pacific Halibut Management Association of British Columbia, Vancouver, BC
Exhibit #49:	Native Fishing Association, Vancouver, BC
Exhibit #50:	Canadian Council of Professional Fish Harvesters, Ottawa, ON
Exhibit #51:	United Fishermen and Allied Workers' Union, Vancouver, BC
Exhibit #52:	Pacific Halibut Management Association of British Columbia, Vancouver, BC
Exhibit #53:	Northern Trollers' Association, Prince Rupert, BC
Exhibit #58:	The Friends of Clayoquot Sound, Tofino, BC
Exhibit #64:	MariCulture Systems, Lake Stevens, Washington, USA
Exhibit #65:	British Columbia Shellfish Growers Association, Duncan, BC
Exhibit #66:	British Columbia Ministry of Fisheries, and BC STATS, Victoria, BC
Exhibit #67-68:	British Columbia Ministry of Fisheries, Victoria, BC

Exhibit #69:	J. Paul & Associates and the British Columbia Ministry of Fisheries, Victoria, BC
Exhibit #70:	J. Paul & Associates and the British Columbia Ministry of Fisheries, Victoria, BC
Exhibit #71:	ARA Consulting Group Inc., Vancouver, BC
Exhibit #72:	British Columbia Ministry of Fisheries, Victoria, BC
Exhibit #74:	Jennifer & Doug Caines, Pools Cove, NF
Exhibit #75:	Coast of Bays Corporation, Harbour Breton, NF
Exhibit #76-77:	Department of Fisheries and Oceans, St. John's, NF
Exhibit #78:	Department of Fisheries and Oceans, Charlottetown, PE
Exhibit #79:	Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, PE
Exhibit #80:	Nova Scotia Aquaculture Association, Halifax, NS
Exhibit #81:	Scotian Halibut Ltd., Clark's Harbour, NS
Exhibit #82:	Cooke Aquaculture, Saddle Island, NS
Exhibit #83:	Residents Association of Southwest and Northwest Cove, West Shore, NS
Exhibit #92	South West Shore Development Authority, Yarmouth, NS
Exhibit #95	Quebec Department of Agriculture, Fisheries and Food, Quebec, QC
Exhibit #96	SeaWeb Aquaculture Clearinghouse, Providence, Rhode Island, USA
Exhibit #97	Newfoundland & Labrador Department of Fisheries and Aquaculture, St. John's, NF

APPENDIX VI

MEETINGS & TOURS

Date	
36th Parliament – 2nd Session	
February 29, 2000	Tour of cage site
TOURS:	Tour of aquaculture facilities of the Department of Fisheries and Oceans and Huntsman Marine Science Centre
St. Andrews-by-the-Sea, N.B.	Tour of Atlantic Salmon Federation Conservation Centre
	Dr. John M. Anderson, Former Director DFO Biological Station, Chairman, Huntsman Marine Science, and Vice-President Operations, Atlantic Salmon Federation
February 29, 2000	**From: Department of Fisheries and Oceans** Dr. Tom Sephton, Director, DFO Biological Station Dr. David Aiken, Leader, Applied Aquaculture Section Dr. Fred Page, Research Scientist Dr. Kats Haya, Research Scientist
MEETINGS:	
St. Andrews-by-the-Sea, N.B.	**From: N.B. Department of Fisheries and Aquaculture** Mr. Paul Aucoin, Deputy Minister Mr. Russell Henry, Research Manager Ms. Kim Lipsett, Acting Director, Aquaculture
	From: Huntsman Marine Science Centre Dr. John H. Allen, Executive Director Dr. Brian Glebe, Program Manager, Atlantic Salmon Broodstock Development Program Mr. Bill Hogans, Aquaculture Specialist
	From: Industry Mr. Glen Brown, President, New Brunswick Salmon Grower's Association Mr. Nell Halse, General Manager, New Brunswick Salmon Grower's Association Mr. Fraser Walsh, Vice-President, Heritage Salmon, Connors Bros. Mr. Lloyd Purdy, General Manager, Jail Island Salmon Ltd. Mr. Bill Robertson, Director, Aquaculture, Connor Bros. Ltd.

From: Atlantic Salmon Federation
Mr. Bill Taylor, President
Dr. Fred Whoriskey, Vice-President, Research and Environment
Mr. Stephen Chase, Vice-President, Government Affairs
Dr.Wilfred M. Carter, President Emeritus
Ms. Sue Scott, Vice-President, Communications and Public Policy

March 1, 2000

MEETINGS:

Murray Corner, N.B.

From: Botsford Professional Fishermen's Association Inc.
Mrs. Donna Murray
Ms. Leslie-Anne Davidson
Ms. Lorelei Grecian
Mr. Réjean Vienneau
Mr. Alfred Arsenault
Mr. Fidèle Arsenault
Mr. Wayne Brownell
Mr. Roderick Pauley
Mr. Hanson Spence
Mr. Tony Trenholm
Mr. Steward Murray
Mr. Gary O'Hanley
Mr. John Dulenty

Shédiac, N.B.

From: The Maritime Fishermen's Union
Mr. Michael Belliveau
Mr. François Beaudin
Mr. Herménégil Robichaud
Mr. Réginald Comeau
Mr. Amédée Savoie
Mr. Léon Lanteigne
Mr. Sylvestre McLaughlin
Mr. Ron Cormier

Moncton, N.B.

From: Aquaculture Acadienne Ltd.
Mr. Maurice Daigle

From: Centpak
Mr. Léo Lanteigne

From: Atlantic Oyster Company
Mr. Paul J. Williams
Mr. Keith Williams

March 2, 2000

MEETINGS:

Îles-de-la-Madeleine, Quebec

From: Fisheries and Oceans Canada
Mr. Roger Simon, Resource Manager and Area Representative

Mr. Sylvain Vigneau
Biologist and Scallop Farmer
Secretary, Quebec Sea Farmers Group
Representative, Sea Farmers
Vice-president, Quebec Fisheries and Aquaculture Group
Member, Quebec Sea Farming Round Table
Member, Board of Directors, Quebec Sea Farming Development Corporation

March 2, 2000

TOUR:

Îles-de-la-Madeleine, Quebec

Tour of Seafood Factory
Mr. Jacques Chevarie
Director
Madeliner Inc.

March 27, 2000	**From: Skeena Queen Charlotte Regional District** Ms. Sheila Dobie
MEETINGS:	Seafood Development Project Coordinator
Prince Rupert, B.C.	**From: BC Chamber of Commerce** Mr. Al Sheppard Chair, Fisheries Committee
	As an individual Mr. Des Nobels Fisherman
	From: Octopus Development Institute Ms. Christina Malaka Chair
	From: Marine Stewardship Council Mr. Peter Scott Certification Officer
	From: Eidsvik & Associates Mr. Odd Eidsvik Chartered Accountant
March 28, 2000	**From: United Fishermen and Allied Workers Union** Mr. Bruce Burrows
MEETINGS:	Marine Protected Area Outreach Coordinator Living Ocean Society, and
Port Hardy, B.C.	Secretary Treasurer, Sointula Local
	From: Raincoast Research Society Ms. Alexandra Morton Whale Researcher

March 28, 2000	Tour – Englewood Packing Company
TOURS:	Mr. Dave Pashley Manager
Port Hardy, B.C.	Ms. Anita Peterson North Island Representative B.C. Salmon Farmers Association
Alert Bay, B.C.	Tour of U'Mista Cultural Centre

March 28, 2000	**From : Village of Alert Bay** Mr. Gilbert Popovich
MEETINGS:	Mayor
Alert Bay, B.C	Mrs. Monique Jeffrey Chief Administrative Officer
	From: Namgis First Nation Mr. Lawrence Ambers Band Manager
	Mr. George Speck Assistant Band Manager
	Mr. Michael Berry Consultant
	Chief William Cranmer
	Richard Dawson
	From: Kwakuitl Territorial Fisheries Commission Mr. Pat Alfred President
	Ms. Maxine Bruce

From: Tsawataineuk First Nation
Chief Willie Moon

Tom Dawson

From: Kwicksutaineuk Ahkwa' mis First Nation
Chief Sandy Johnson

Ms. Dory Johnson

From: Gwawaenuk First Nation
Chief Charlie Williams

Fred Speck

From : Musgamagw Tsawataineuk Tribal Council
Yvon Gesinghaus
General Manager

MEETING :

From: Orca Research
Dr. Paul Spong

March 29, 2000	Tour of Salmon Farm
TOUR:	Mr. Marcel Gijssen Tofino/ South Island Representative
Tofino, B.C	B.C. Salmon Farmers Association
	Mr. Harry K. Hammer President Prime Pacific Seafarms
	Mr. William G. Vernon General Manager Creative Salmon Company Ltd.
March 29, 2000	**From: West Coast Sustainability Association** Mr. Dan Edwards
MEETINGS:	Executive Director
Ucluelet, B.C	Mr. Trevor Wickham Programs Coordinator
	From: Regional Aquatic Management Society (RAMS) Ms. Brenda Bauer Executive Director
	From: Friends of Clayoquot Sound Dr. Sergio Paone Research and Education Coordinator
	From: Tanner Crab Project Ms. Julie Edwards Project Coordinator
March 29, 2000	Tour of Hake Plant
TOUR:	Mr. Mike Buston Manager
Ucluelet, B.C	Ucluelet Seafood Processors

March 29, 2000

MEETINGS:

Ucluelet, B.C

From: Nuu-chah-nulth Tribal Council
Mr. Don Hall
Mr. Roy Alexander
Mr. Archie Little
Mr. Richard Watts

From: Ucluelet First Nation
Mr. Gordon Taylor

From : British Columbia Aboriginal Fisheries Commission
Mr. Simon Lucas

March 30, 2000	**From: The David Suzuki Foundation** Ms. Lynn Hunter
MEETINGS:	Fisheries and Aquaculture Specialist
Duncan, B.C	**From: Cowichan Fishermen's Association** Mr. John Hird President
	From: Georgia Strait Alliance Ms. Laurie MacBride Executive Director
	Mr. Howard Breen Campaign Coordinator
	From: West Coast Trollers Ms. Kathy Scarfo President
	From: University of Victoria Dr. John Volpe Centre for Environmental Health Department of Biology
	From: Coastal Communities Network Mr. Dale Smith Executive Director
	Mr. Bruce Milne Mayor, Schelt
March 31, 2000	**From: Fisheries Renewal** Mr. Paul Kariya
MEETINGS:	Chief Executive Officer
Duncan, B.C	
Vancouver, B.C.	**From: B.C. Fisheries Survival Coalition** Mr. Phil Eidsvik Executive Director

From : United Fishermen & Allied Workers Union
Mr. David Lane
Director of Research

From: Taplow Feeds
Dr. Brad Hicks

From: B.C. Seafood Alliance
Ms. Michelle James
Executive Director

From : Native Fishing Association
Mr. Edwin Newman
President

From: Native Brotherhood of B.C.
Mr. Chris C. Cook Jr.
President

As individuals
Ms. Karen Wilson
Mr. Richard Nomura
Mr. Mike Forrest
Mr. Doug Massey

June 5, 2000

MEETINGS:

Gander, Nfld.

From: Fisheries and Oceans Canada
Mr. Jim Davis, Chief
Commercial Analysis & Investment Division
Policy & Economics Branch
Northwest Atlantic Fisheries Centre

Mr. Vern Pepper
Biologist, Aquaculture Research
Science Branch

Mr. Larry Yetman
Program Officer, Aquaculture

June 5, 2000

TOUR:

Harbour Breton, Nfld.

Tour by boat of Mussel Operations

From: Newfoundland & Labrador Department of Fisheries & Aquaculture
Mr. Gerry Ward
Deputy Minister, Aquaculture

Ms. Elizabeth Barlow
Salmonid Aqua Culturalist

From: Town of Harbour Breton
Mr. Churence Rogers
Mayor

From: Coast of Bay Corporation
Ms. Tracey Perry
Executive Director

Boat Operator, The Lady Sarah
Mr. Walter Vallis

From: Con-Aqua Mussel Farm
Mr. Travis Mahoney
Production Manager

June 5, 2000

MEETING:

Pool's Cove, Nfld.

From: Shell Fresh Farms

Doug and Jennifer Caines

June 6, 2000	Tour by boat to Margery Cove
TOURS:	Mr. Gerry Barter Boat Owner
St. Alban's , Nfld.	The Sandra & Delphine
	Mr. Clyde Collier Production Manager Miawpukek Aquaculture Inc.
	Tour of Fish Hatchery
	Mr. Brian Hull Hatchery Manager SCB Fisheries
	Mr. Daryl Whelan Fish Farm Veterinarian Nfld. & Labrador Dept. of Fisheries and Aquaculture
June 6, 2000	Tour of Atlantic Shellfish Company
TOUR:	Mr. Russell Dockendorff Jr. President
St. Peter's Bay, P.E.I.	

June 7, 2000

MEETINGS:

Charlottetown, P.E.I.

From: PEI Department of Fisheries and Tourism
Mr. Lewis P. Creed
Assistant Deputy Minister

Mr. Richard Gallant
Aquaculture Specialist

From: PEI Aquaculture Alliance
Ms. Crystal MacDonald
Executive Director

From: Fisheries and Oceans Canada
Mr. Dale Small
Chief, Aquaculture Division

June 7, 2000

MEETINGS:

Charlottetown, P.E.I.

From: Veterinary College
University of Prince Edward Island

Dr. Tim Ogilvie, Dean, Atlantic Veterinary College
Dr. Larry Hammell, Coordinator, Fish Health
Dr. Gerry Johnson
Dr. Jeff Davidson

June 8, 2000

MEETINGS:

Yarmouth, N.S.

From: Fisheries & Oceans Canada
Mr. Darrell Harris, Senior Advisor Aquaculture
Aquaculture Coordination Office

From: N.S. Department of Fisheries, Aquaculture Division
Mr. Andrew Bagnall, Supervisor of Extension Services
Aquaculture Division

From: Aquaculture Association of Nova Scotia
Ms. Marli MacNeil
Executive Director

June 8, 2000	Tour of Aquaculture Facilities (land-based operation)
TOUR:	
Woods Harbour, N.S.	

June 8, 2000	**From: Scotian Halibut** Mr. Peter Swimm
MEETING:	President
Woods Harbour, N.S.	Mr. Brian Blanchard Manager

June 8, 2000	Tour by boat of Aquaculture Facilities
TOUR :	
Port Mouton, N.S.	

June 8, 2000	**From: Port MoutonAqua Gem Farms Ltd.** Mr. Mike Raynard
MEETING:	President
Port Mouton, N.S.	

June 8, 2000	**From: Cooke Aquaculture** Mr. Glen Cooke, Chief Executive Officer
MEETING:	Mr. Jim Dunphy, Chief Operating Officer Mr. Bob Sweeney, Executive Director, Development
Western Shore, N.S.	Mr. Mike Szemerda, Seawater Products Manager

June 9, 2000	**From: Residents Association of Southwest & Northwest Cove**
MEETING:	Mr. Philip Lamont Businessman; and
Western Shore, N.S.	Secretary-Treasurer of the Southwest Cove Yacht Club
	Mr. Lawson Miller Fisherman; President, Seldon Miller Fisheries; and Secretary-Treasurer, Harbour Authority of Northwest Cove
	Mr. Vincent Boutillier Fisherman
	Mr. Peter Cobbold Businessman
June 9, 2000	Tour by boat of salmon cages (Cooke Aquaculture)
TOUR:	
Saddle Island, N.S.	
June 9, 2000	Tour by boat to see mussels harvesting and tour of plant
TOUR:	
Mahone Bay, N.S.	
June 9, 2000	**From: Indian Point Marine Farms** Mr. Peter Darnell
MEETING:	President
Mahone Bay, N.S.	